

BBC

From the makers of **FOCUS**  
SCIENCE AND TECHNOLOGY



SPECIAL EDITION

# EARTH FROM SPACE

YOUR HOME AS YOU'VE NEVER SEEN IT BEFORE

**VOLCANOES**  
**ANCIENT SITES**  
**RIVERS DESERTS**  
**ISLANDS FARMING**  
**HURRICANES CITIES**  
**OCEANS CLOUDS REEFS**



# Explore the world of

# FOCUS

## SCIENCE AND TECHNOLOGY



### FACEBOOK

Keep your finger on the *Focus* pulse by heading to Facebook. 'Like' us at [www.facebook.com/sciencefocus](http://www.facebook.com/sciencefocus)



### PODCAST

Every month we interview the finest minds in science – listen at [sciencefocus.com/podcasts](http://sciencefocus.com/podcasts)



### TWITTER

Follow us at [twitter.com/sciencefocus](https://twitter.com/sciencefocus) for the latest science news and events



### WEBSITE

Catch up with the latest news stories and blogs, check out tech reviews and win great prizes at [www.sciencefocus.com](http://www.sciencefocus.com)



### DIGITAL EDITIONS

Read *Focus* on your Apple iPad, Google Nexus or Kindle Fire tablet. You can also download *Focus* from Zinio.com to read on any computer



### SPECIAL EDITION

No subject is too mind-bending for *Focus* to tackle. You'll find 20 of the biggest ideas covered in this special issue

# WELCOME



FOR MOST OF recorded history, people have wondered what Earth would look like from up high. Socrates imagined something not a million miles away from a football: "The world, when viewed from above, resembles a ball sewn from twelve pieces of skin," he wrote around 2400 years ago.

It wasn't until 1946 that a camera at last captured views of Earth from space. It was mounted on

a V-2 – a missile developed by the Germans in World War II and captured by the Americans. Launched from New Mexico, it took its picture from an altitude of 105km.

Before long, rockets were regularly carrying payloads into orbit and 1959 saw the first satellite image taken from space. A blurred, black-and-white picture of the Pacific Ocean, the Explorer 6 photo is a far cry from the colourful, high-resolution images you'll find in this special issue of *Focus*. From volcanoes, storms and rivers to cities and the remarkable extent of human impact, these images reveal a panoply of activity on Earth.

My favourite photos show Earth at night; whole continents that never

sleep. It's a reminder of just how much of the globe we've covered with infrastructure in order to sustain intelligent life on our planet.

I often wonder what Earth will look like in 50 years' time. Will even more of the planet's surface glow and twinkle with artificial light? Or will our desire to conserve energy plunge us into darkness once more? Only time will tell, but for now, sit back and enjoy what only astronauts have seen with their own eyes: our home, whole.

**Graham Southorn,**  
Editor

*Graham*

## CREDITS

### EDITORIAL

Editor-in-Chief **Paul McGuinness**  
Editor **Graham Southorn**  
Production Editor **Mel Woodward**  
Subeditor **Rebecca Candler**  
Editorial Assistant **Emma Jolliffe**

### ART & PICTURES

Art Editor **Shou-Kuei Ho**  
Designer **Lisa White**  
Picture Editor **James Cutmore**  
Picture Researcher  
**Rhiannon Furbear-Williams**

### PRESS AND PUBLIC RELATIONS

Press Officer **Carolyn Wray** 0117 314 8812  
[carolyn.wray@immediate.co.uk](mailto:carolyn.wray@immediate.co.uk)

### CIRCULATION / ADVERTISING

Circulation Manager **Rob Brock**  
Advertising Director **Caroline Herbert**

### PRODUCTION

Production Director **Sarah Powell**  
Production Co-ordinator **Derrick Andrews**  
Reprographics **Tony Hunt and Chris Satch**

### PUBLISHING

Publisher **Andrew Davies**  
Publishing Director **Andy Healy**  
Managing Director **Andy Marshall**  
Chairman **Stephen Alexander**  
Deputy Chairman **Peter Philipp**  
CEO **Tom Bureau**

WITH THANKS TO Oliver Lee

## Like what you've read?

Email us at [bookazines@immediate.co.uk](mailto:bookazines@immediate.co.uk)

© Immediate Media Company Bristol 2015. All rights reserved. No part of *Earth From Space* may be reproduced in any form or by any means either wholly or in part, without prior written permission of the publisher. Not to be resold, lent, hired out or otherwise disposed of by way of trade at more than the recommended retail price or in published condition. Printed in the UK by William Gibbons Ltd. The publisher, editor and authors accept no responsibility in respect of any products, goods or services which may be advertised or referred to in this issue or for any errors, omissions, misstatements or mistakes in any such advertisements or references.



**IMMEDIATE  
MEDIA** <sup>GR</sup>

FRONT COVER PHOTO: ALAMY BACK COVER PHOTO: NASA



## Sunrise

THIS DRAMATIC IMAGE of a sunrise was taken by astronauts travelling at over 27,000km/h. At these speeds it only takes 90 minutes to orbit the planet, allowing them to see 16 sunrises and 16 sunsets every day.

PHOTO: KEVIN KELLEY/GETTY



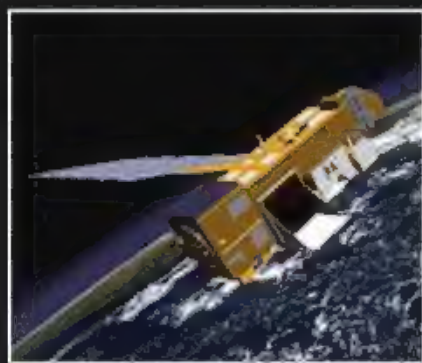
# CONTENTS



- 6** Introduction
- 10** Water
- 20** Landmarks
- 32** The Cold Earth
- 42** Human Impact
- 54** Clouds
- 66** Cities
- 76** The Hot Earth
- 88** Earth At Night
- 96** Subscriptions
- 98** Parting Shot



# INTRODUCTION



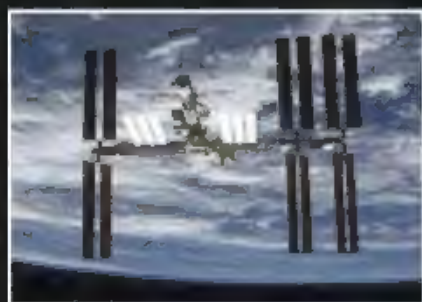
TERRA



GeoEye-1



IKONOS



International Space Station

**O**N CHRISTMAS EVE 1968, Apollo 8 astronaut Bill Anders took a photo of an 'Earthrise' from the Moon's orbit. As the first image showing how Earth appeared from deep space, it awakened a huge interest in photographing our planet.

In 1972, NASA launched the first satellite that had the sole intent to monitor Earth's landmasses. It was called Landsat 1, and although it retired in 1978, the mission continues. Landsats 5, 7 and 8 all contribute images to *Earth From Space*. With the fleet's focus being on Earth's resources, their pictures provide great insight into the impact of human society.

Satellites allow us to study and analyse many of Earth's previously unexplained processes. It's no coincidence that advances in weather prediction and natural disaster aversion all align with the rise of these orbiting devices. As technology has rocketed, so too has

the quality and variety of recordings that satellites take. The complex images are far more than just colour photos - the sensor onboard NASA's Suomi NPP satellite, for instance, measures electromagnetic radiation. Orbiting between the poles, Suomi NPP provides data essential to understanding climate change.

Another of NASA's research missions is its TERRA satellite. It has five different image sensors, three of which provide spectacular pictures for this collection. The cameras each have different roles. One captures images of the surface, while another focuses on recording the atmosphere, clouds and land in a three-dimensional manner. Meanwhile a third instrument - the Moderate-Resolution Imaging Spectroradiometer (MODIS) - picks up atmospheric, land surface, and cryospheric features across the globe. There's another MODIS sensor on NASA's Aqua satellite, which observes Earth's water.




## The blue planet

▲ ONE OF THE first photos of the Earth in a single image. Shot by an Apollo 8 astronaut, it shows the planet at a distance of about 30,000km, with Antarctica at the top of the picture.

PHOTO: NASA





## Great divide

### California and Nevada, USA

THE SIERRA NEVADA mountains trap moist sea air as it blows in off the Pacific Ocean, creating a lush green haven along the west coast, and an arid landscape in the eastern interior.

© 2000 BBC





monitoring seas, rivers, ice, clouds and even soil.

Photos from two of the planet's most cutting-edge imaging satellites also feature in this collection - GeoEye-1 and IKONOS. The high-resolution images from GeoEye-1 are the most detailed views of Earth that exist, while IKONOS captures multispectral images - showing data from beyond the visible light range - and black-and-white, or panchromatic, images.

With a rise in commercial satellites like GeoEye-1, the costs attached to these monitors have reduced, but still, the minimum price tag on a launch is £33m. So, when a satellite makes it into orbit, it is worth taking advantage of. Launched in 2000, NASA's Earth Observing-1 (EO-1) satellite was only intended for a year-long mission. But

the device proved so successful that it still runs today. EO-1 provides a wealth of pictures, from wide-angle land shots to hyperspectral images that scientists use to classify complex ecosystems.

It's not only satellites that watch us - permanently onboard the International Space Station (ISS) is a rotating crew of six astronauts, plus a host of Earth-monitoring instruments. Thanks to its low Earth orbit, the ISS looks down at a shallow angle, so its images provide a rare view of our world.

Those Apollo astronauts set off on their missions in the bold spirit of exploration. In the half century since, the ISS has taken shape, while thousands of satellites watch the globe. The spirit of Apollo lives on and, thanks to the amazing images in this special edition, we can all enjoy an astronaut's eye view.

## The Colosseum Rome, Italy

▲ **ALTHOUGH IT WAS** built nearly 2100 years ago, this ancient amphitheatre stands tall. The 20,000m<sup>2</sup> site sits in the top left of this picture, surrounded by the modern city.

PHOTO: DIGITALGLOBE/GETTY

## Island paradise The Bahamas

► **THE VIVID BLUE** waters of The Bahamas owe their practically luminous quality to the shallow depths of their seas.

PHOTO: NASA/JEFF SCHMALTZ





## Fort Bourtange

### The Netherlands

▲ THIS UNIQUE STAR fortress lies near the German border. The original structure was built in 1593 and served defensively for nearly two centuries. After a 25-year reconstruction project, the fort is now a museum.

PHOTO: DIGITALGLOBE

## Tornado track

### Massachusetts, USA

► ON 1 JUNE 2011, a 63km track of destruction – the pale-brown line that runs through the middle of this picture – was carved out by a single twister. At about 800m wide, the tornado ravaged residential and forest areas.

PHOTO: NASA/JESSE ALLEN







# WATER

With water covering over 70 per cent of Earth's surface, it's easy to see why it's called the 'blue planet'. Meandering streams and serene lagoons can be inviting, but the unpredictability of water makes it a dangerous opponent





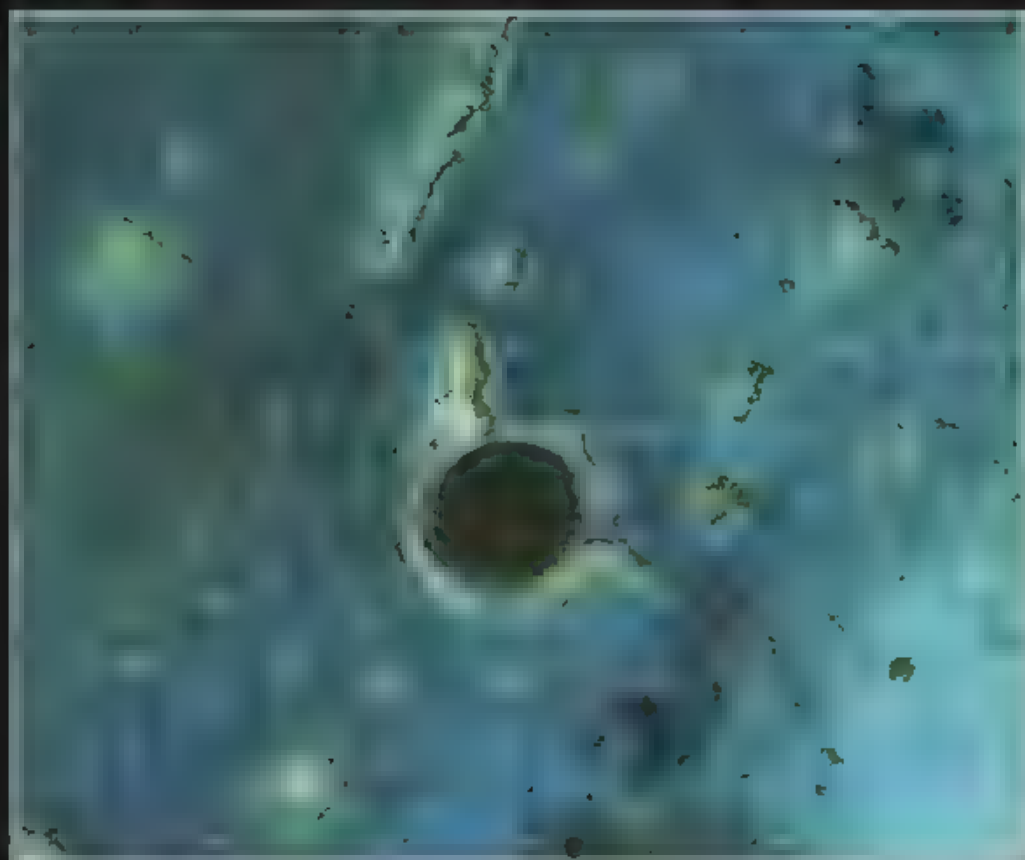


## Great Blue Hole

Belize

► THIS SPECTACULAR underwater sinkhole is part of the Belize Barrier Reef Reserve System. A favourite among scuba divers, the circular cave is 300m wide and 124m deep. In the last Ice Age, sea levels were up to 120m lower than today. Rain eroded the limestone surface creating a cave. As the ocean began to rise again, the cave was flooded, resulting in the Great Blue Hole.

PHOTO: DIGITALGLOBE

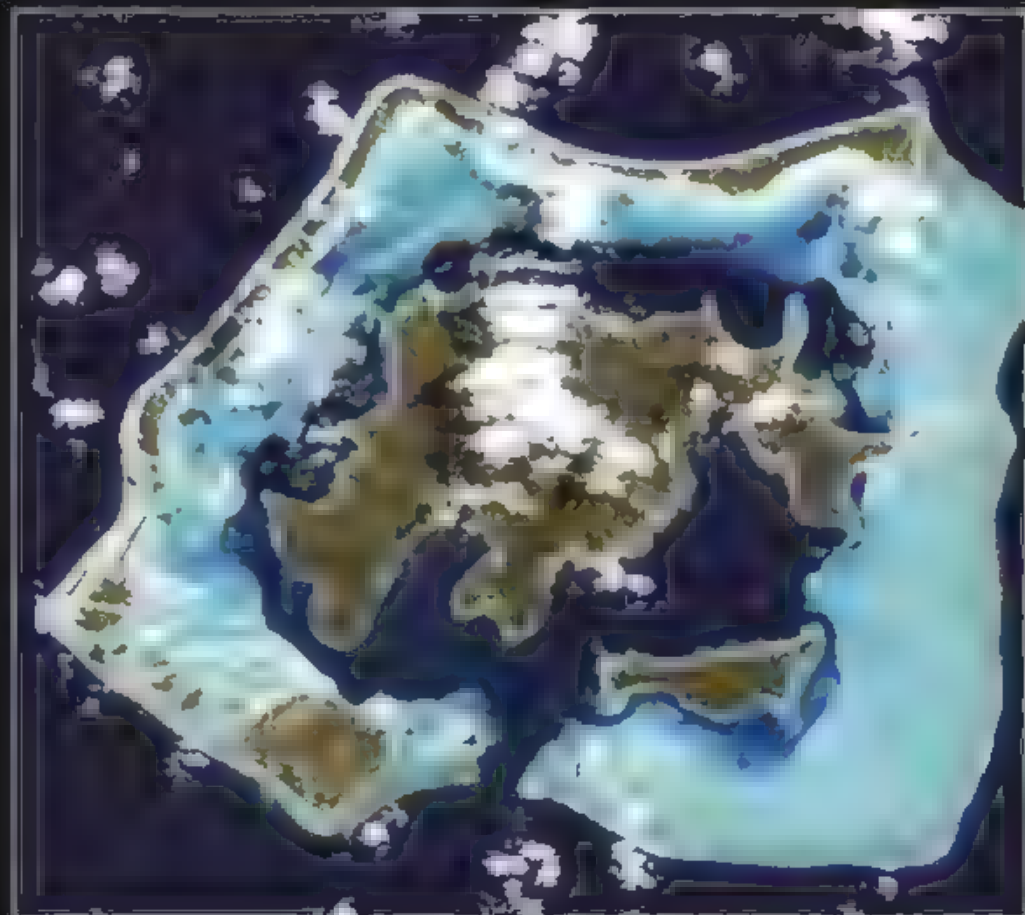


## Bora Bora

French Polynesia

► IN THE MIDDLE of the Pacific Ocean, surrounded by a lagoon and barrier reef, Bora Bora's volcanic land rises from the sea. After the volcano became extinct, the island started to subside. Coral grew, building a fringing reef around the island and creating the lagoon. As the island continued to sink, the barrier reef grew bigger.

PHOTO: DIGITALGLOBE/GETTY





## Lagoons

### New Caledonia

OVER 1000KM EAST of Australia lie the stunning lagoons and reefs of New Caledonia. The shallow waters are home to a large array of species including humpback whales, sea snakes and dugongs.

PHOTO: NASA





## Amazo River

1880

1880

1880

1880

1880

1880

1880

1880

1880

1880

1880

1880

1880

1880

1880

1880

1880

1880

1880

1880

1880

1880

1880

1880

1880

1880

1880

1880

1880

1880

1880

1880

1880

1880

1880

1880

1880

1880

1880

1880

1880

1880

1880

1880

1880

1880







## Khôr Al-Adaid

South Qatar

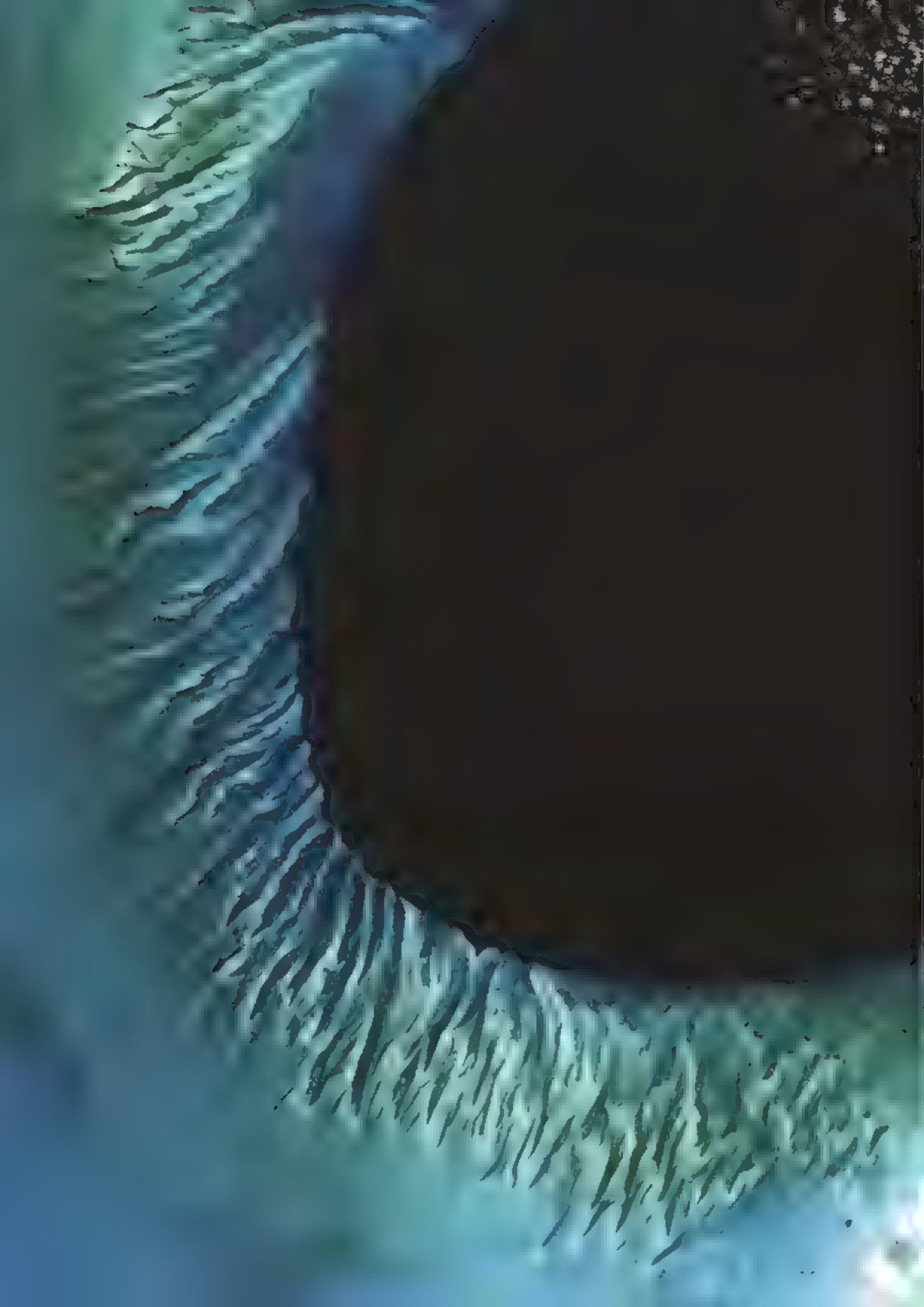
AMIDST TOWERING SAND dunes lies Khôr Al-Adaid, known to locals as the Inland Sea. It's connected to the Persian Gulf by a deep, narrow channel. Here, the ebb and flow of the tide causes the deeper waters to swirl the Arabian sand, which forms this spectacular tree-like pattern.

PHOTO: DIGITAL GLOBE









## Sand and seaweed

Bahamas

◀ THE 'TONGUE OF The Ocean' is a deep oceanic trench separating the islands of Andros and New Providence in The Bahamas. The blackness of the trench highlights the depth of the water in contrast with the turquoise sand and seaweed beds surrounding it. Ocean tides and currents have sculpted the sand into these mesmerising formations.

PHOTO: NASA/SERGE ANDREFOUET

## Aftermath

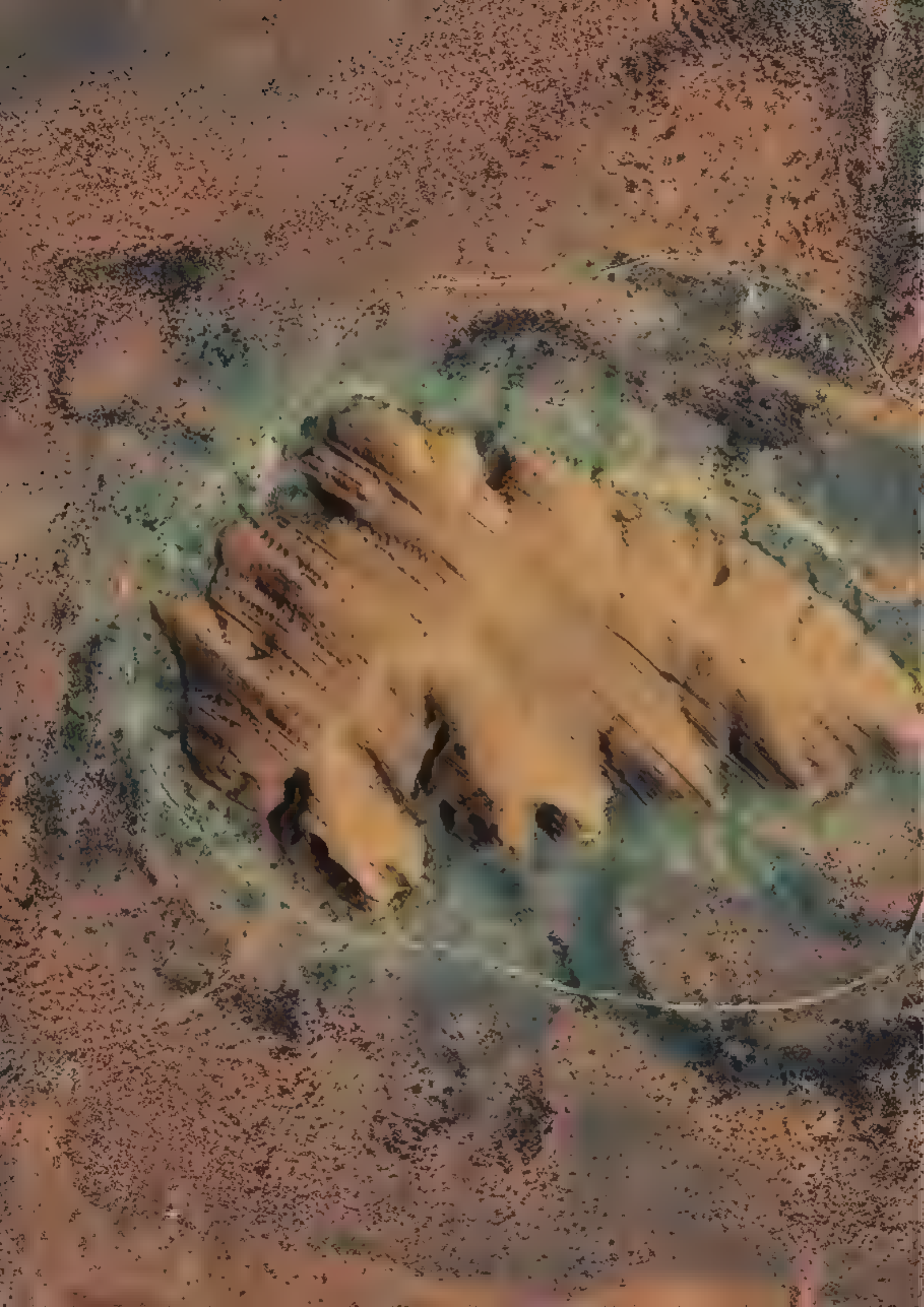
Sendai, Japan

▼ THE BEAUTY OF water is undeniable, but its inner beast is never far away. This image shows the devastation caused by the 9.0 magnitude earthquake on 11 March 2011, which triggered the destructive tsunami, claiming the lives of over 15,000 people.

PHOTO: DIGITALGLOBE







# LANDMARKS

There are many sites that define a landscape, both natural and human-made. While they're fascinating from the ground, viewing them from above gives a whole new perspective

## Uluru

Northern Territory,  
Australia

RIISING UP FROM the arid Australian Outback is Ayers Rock, or Uluru as it's known to the Aboriginal people. At 348m high and 3.6km long, it is claimed by many to be the largest rock in the world. At dawn and sunset, Ayers Rock appears to glow a deep red shade.

PHOTO: NASA

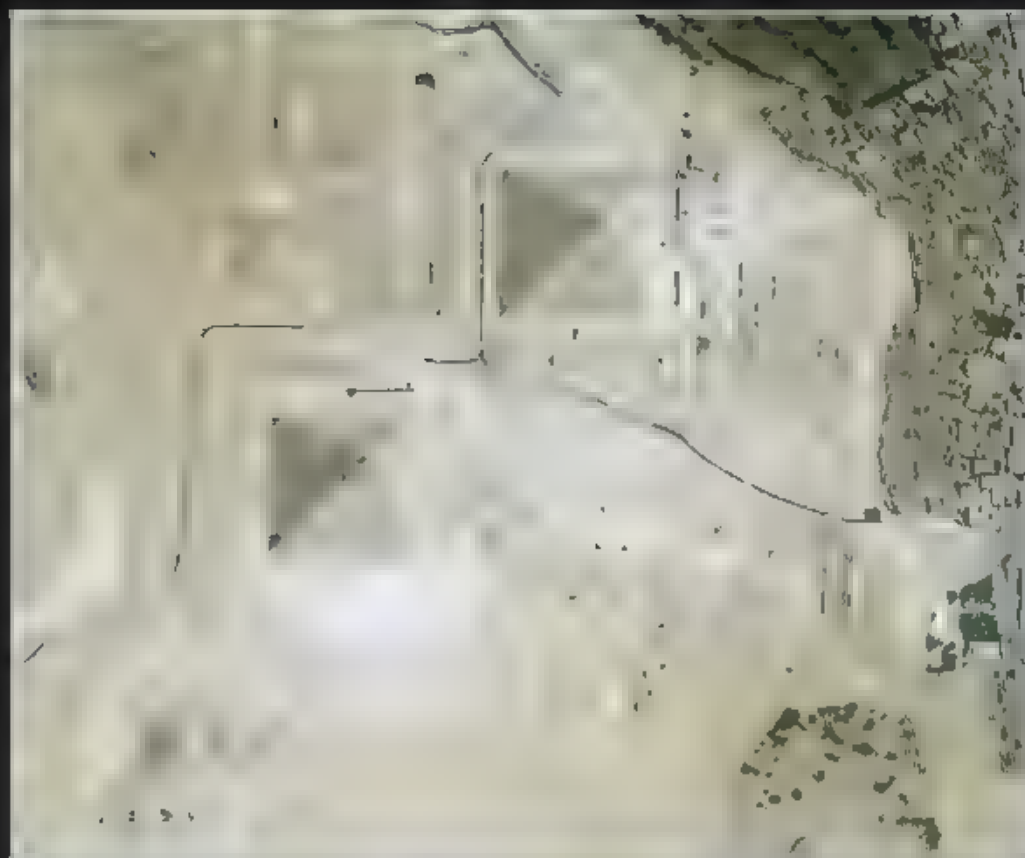


## Giza Necropolis

Near Cairo, Egypt

► THREE HUGE PYRAMIDS and the Great Sphinx make up the Giza Necropolis. The Great Pyramid (top), is the oldest of the Seven Wonders of the Ancient World. It was also the world's tallest human-made structure for over 3800 years.

PHOTO: DIGITALGLOBE/GETTY

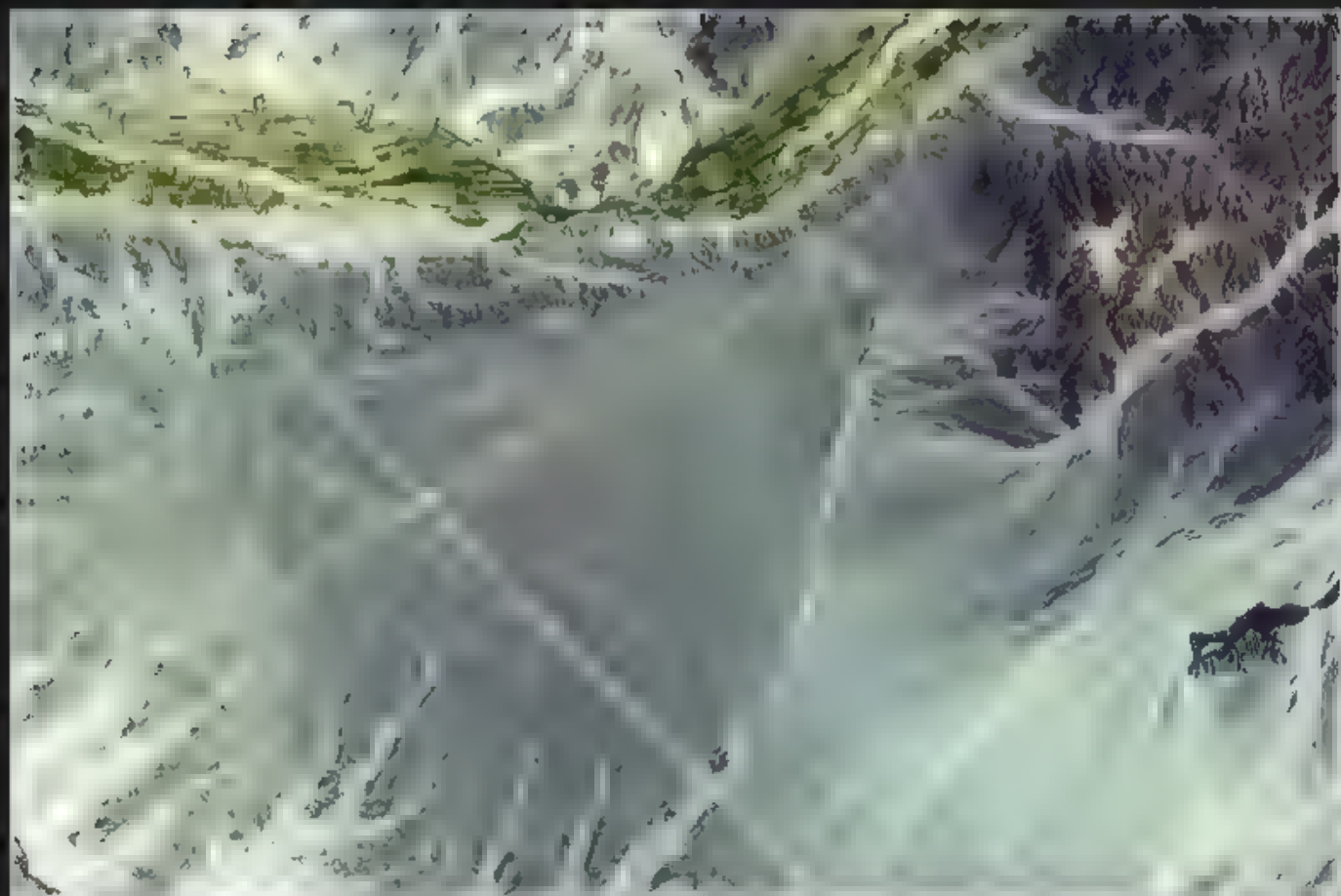


## Nazca Lines

Ica region, Peru

▼ THEY WERE CREATED nearly 2000 years ago, yet the meaning behind these ancient designs remains unknown. The lines were made by removing the reddish pebbles that covered the surface to expose the pale ground below.

PHOTO: NASA/GSFC/ASTER





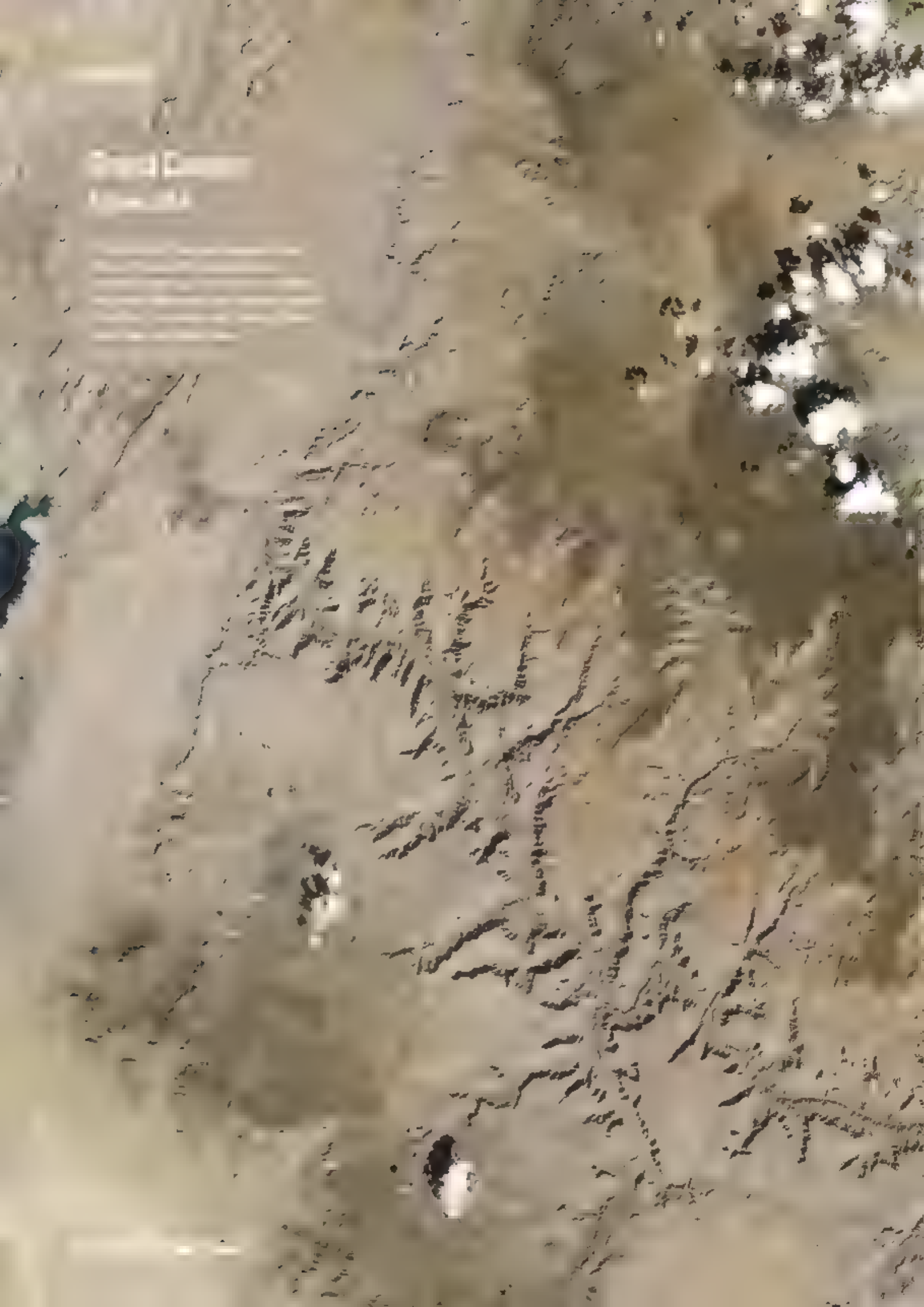
## Taj Mahal

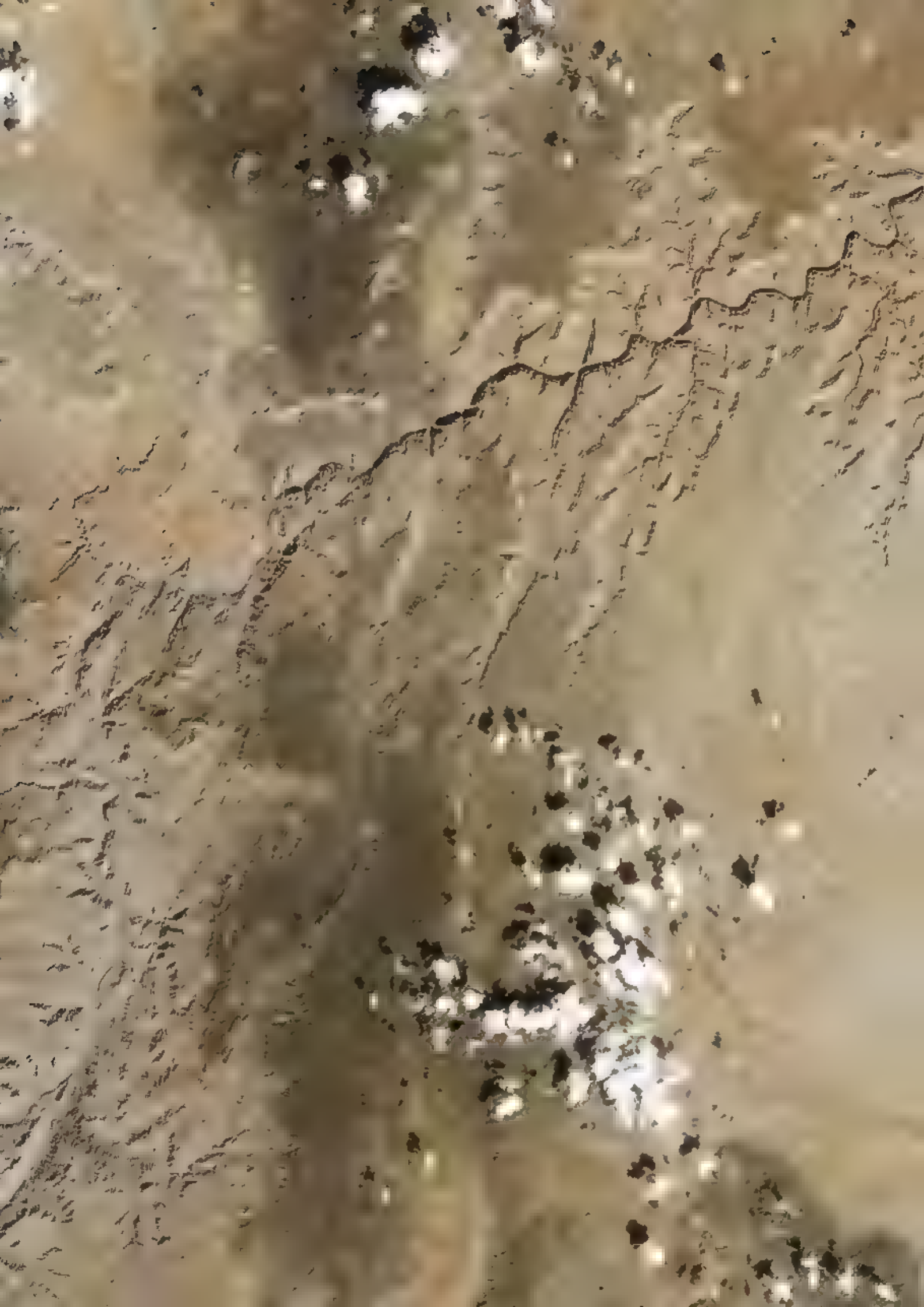
Agra, India

COMPLETED IN 1653, the Taj Mahal was commissioned by Emperor Shah Jahan as a mausoleum for his third wife. Legend has it that he wanted to create a mirror image of it in black marble across the river but died before it was built.

PHOTO: DIGITALGLOBE/GETTY









## Machu Picchu

Cusco region, Peru

BUILT IN THE 15th Century at an altitude of 2430m, Machu Picchu remains one of the most famous Incan cities in the world. Yet the site was abandoned just 100 years after it was built. Known only to the locals for centuries, it was rediscovered by the American explorer Hiram Bingham in 1911.

PHOTO: SATELLITE IMAGING CORP/GEVEY





## Chichen Itza

Yucatán, Mexico

◀ EL CASTILLO, THE towering, stepped pyramid, is the most famous of the Mayan city's ruins. It has 365 steps – 51 on each side plus one on the top – one for each day of the year.

PHOTO: SATELLITE IMAGING CORP.

## Stonehenge

Wiltshire, UK

▼ NOBODY KNOWS HOW or why Stonehenge was built. Using radiocarbon dating, archaeologists believe it dates from between 3000-2000 BC.

PHOTO: SATELLITE IMAGING CORP.









## Niagara Falls

USA and Canada

WITH A VERTICAL drop of 50m, Horseshoe Falls is the biggest of the three waterfalls that make up Niagara Falls. At its peak, a combined total of 5700m<sup>3</sup> of water flows over the



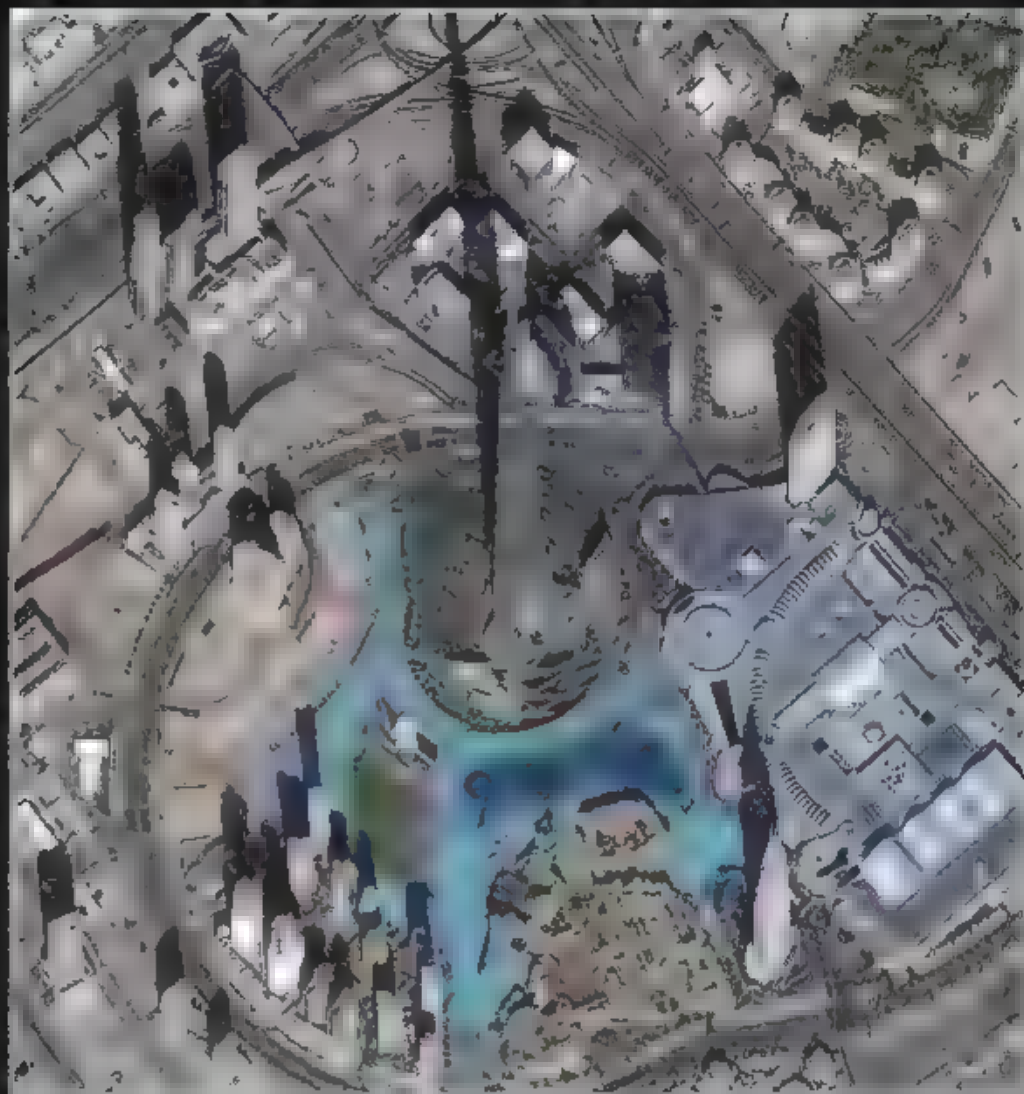
## LANDMARKS

### Burj Khalifa

Dubai, UAE

► **STANDING AT 828.6m**, the Burj Khalifa is the tallest building in the world. It took over five years to build and cost just under \$1.5bn. It holds many world records, including the world's highest nightclub (144th floor).

PHOTO: DIGITALGLOBE/GETTY



### Inauguration

Washington, DC, USA

20 January 2009

▼ **ON A COLD winter's day**, over one million people gathered to witness the first inauguration of Barack Obama, the 44th President of the United States of America.

PHOTO: DIGITALGLOBE/GETTY





## The Forbidden City

Beijing, China

FOR ALMOST 500 years, the Forbidden City was home to the Chinese Emperor. At 961m long and 753m wide, it is the world's largest palace complex. Nobody was allowed in without the Emperor's permission, hence its name.

PHOTO: DIGITALGLOBE/GETTY





# THE COLD EARTH

The poles are melting faster than ever before, but now there's snow in the desert—both signs that our planet's climate is changing rapidly

## Kenai Fjords Alaska, USA

BEAR GLACIER IS the largest of over 30 glaciers in Kenai Fjords. Once, ice would have covered the entire area. Since the 1940s, the glacier has been slowly retreating, which has created Strohn Lake at its base.

PHOTO: NASA/GEDEYE





## South Pole

### Antarctica

Antarctica is the world's largest desert, with some areas almost never seeing precipitation. It's twice the size of Australia and 98 per cent of it is covered in ice, at an average thickness of 1.6km. The continent has 90 per cent of the world's ice, which if melted, would raise sea levels by about 60m.

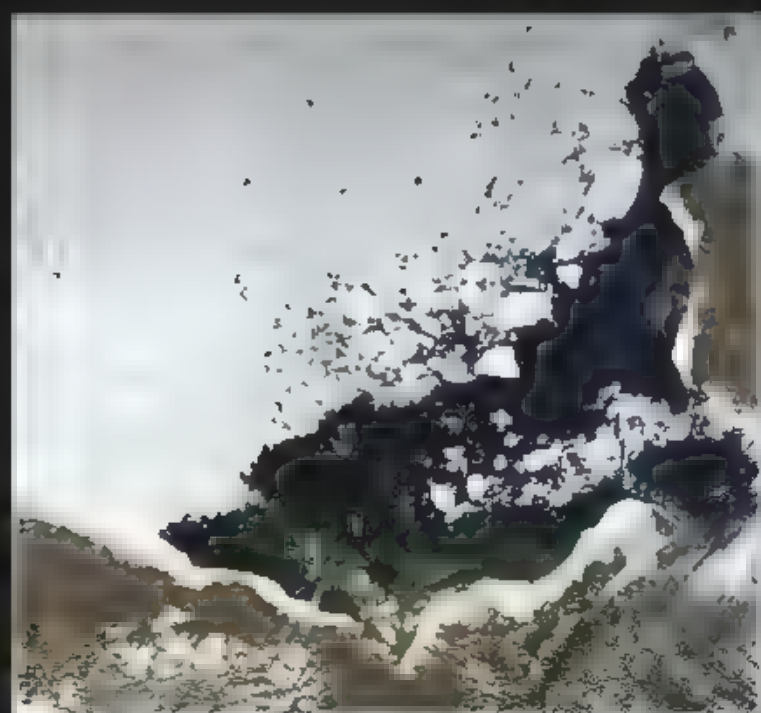
PHOTO: NASA/USFQ

## Beaufort Sea

Alaska, USA

▼ THE IMAGE BELOW shows ice and snow off the coast of Alaska in May 2012. The bottom image is of the same area one month later. Ice retreat is common in June. However, this summer it was particularly rapid – up to 150,000km<sup>2</sup> of ice melted each day, double the normal rate.

PHOTO: NASA/JESSE ALLEN (LACS)





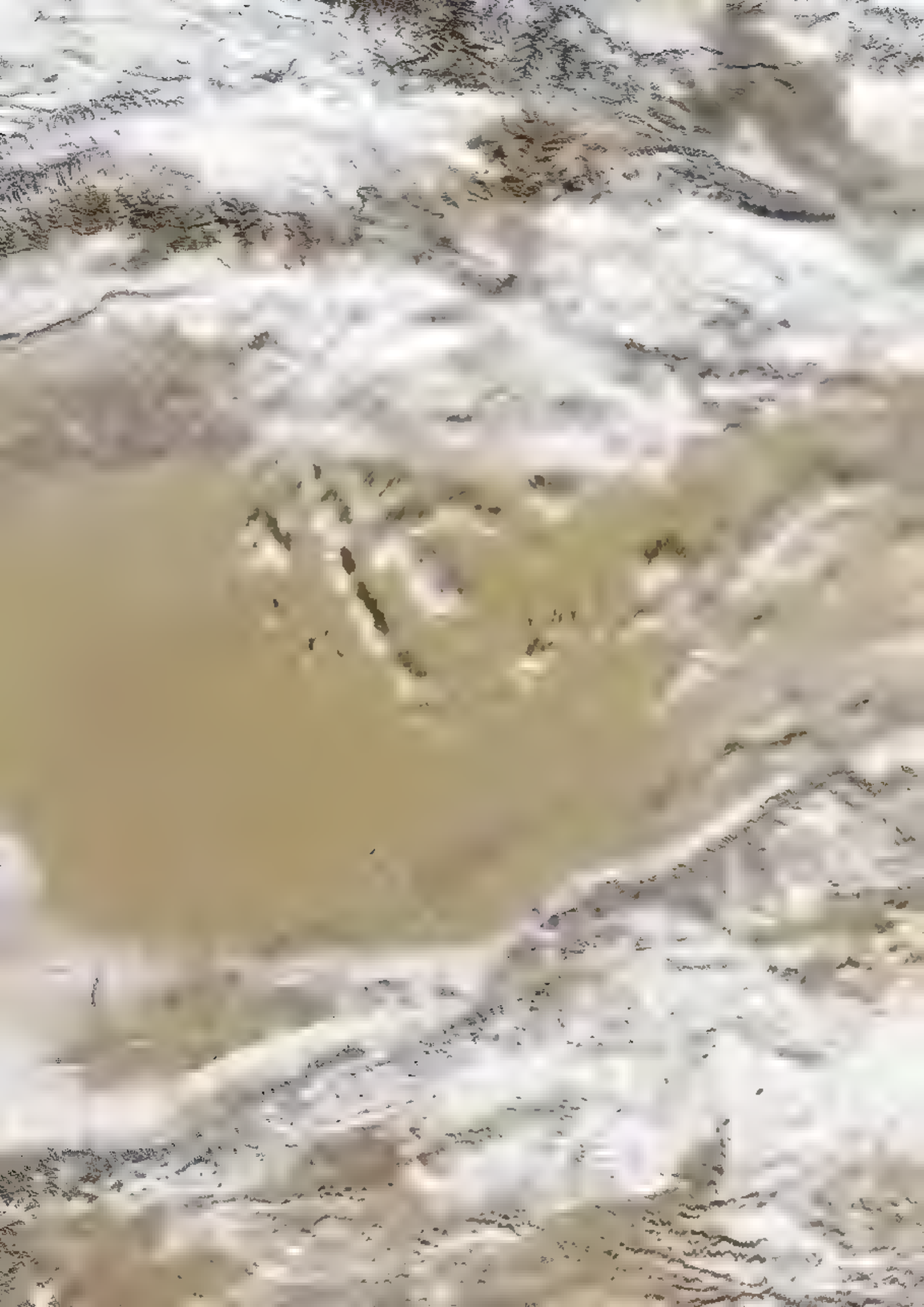
An aerial photograph of the Taklimakan Desert in China, showing a vast, undulating landscape covered in a thick layer of snow. The terrain is characterized by dark, winding ridges and valleys, creating a complex, textured pattern across the entire scene. The lighting is soft, highlighting the contours of the land and the uniformity of the snow cover.

## Taklimakan Desert

### China

THE WINTER OF 2007/2008 saw snow recorded in the Taklimakan Desert for the first time. While this was record-breaking, elsewhere the harsh weather damaged buildings, destroyed crops and claimed hundreds of lives.

PHOTO: NASA, JEFF SCHUBERT





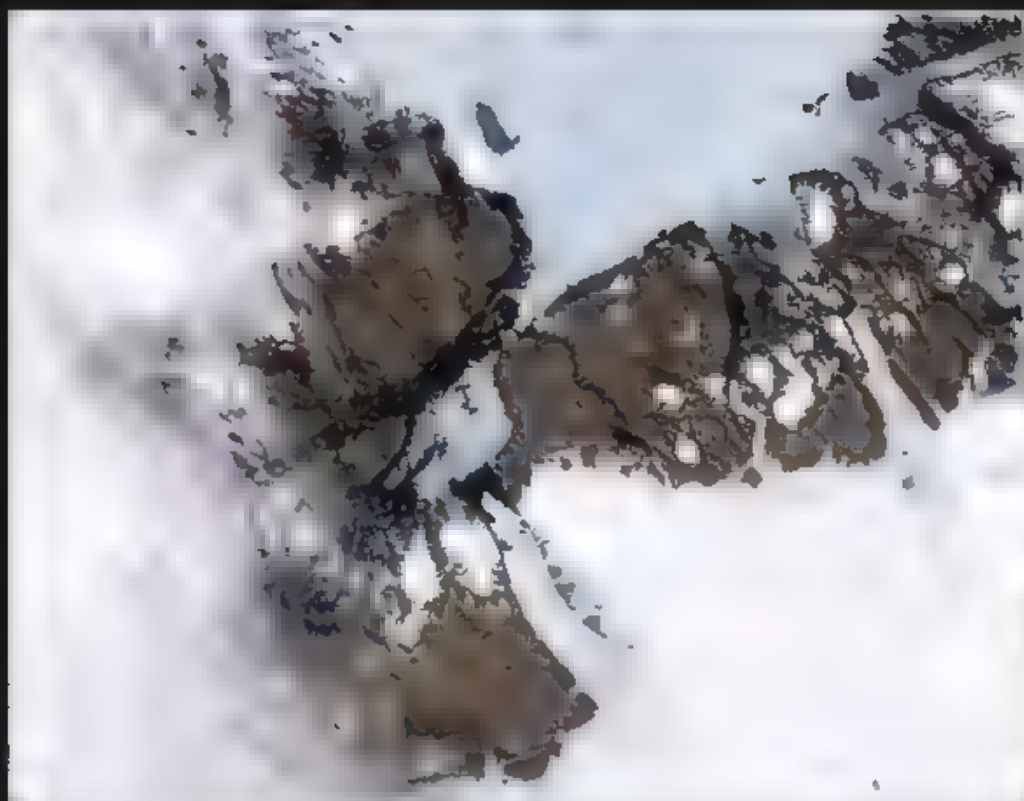
An aerial photograph of the British Isles, including Great Britain and Ireland, completely covered in a thick layer of snow. The snow is bright white, contrasting with the dark, snow-free outlines of the landmasses and the surrounding sea. The texture of the snow appears slightly grainy, and the overall scene is a high-contrast black and white image.

## British Isles

7 January 2010

THE UK CAME to a halt when temperatures reached  $-18^{\circ}\text{C}$  and snow covered the majority of the country. The cold snap started back in November with December being the coldest for 100 years.

PHOTO: NASA/JEFF SCHMALTZ



## Petermann Glacier

### Greenland

ON 5 AUGUST 2010, a chunk of ice larger than Washington, DC, broke off the Petermann Glacier. It produced the largest iceberg in nearly 50 years and reduced the 70km long glacier by a quarter.

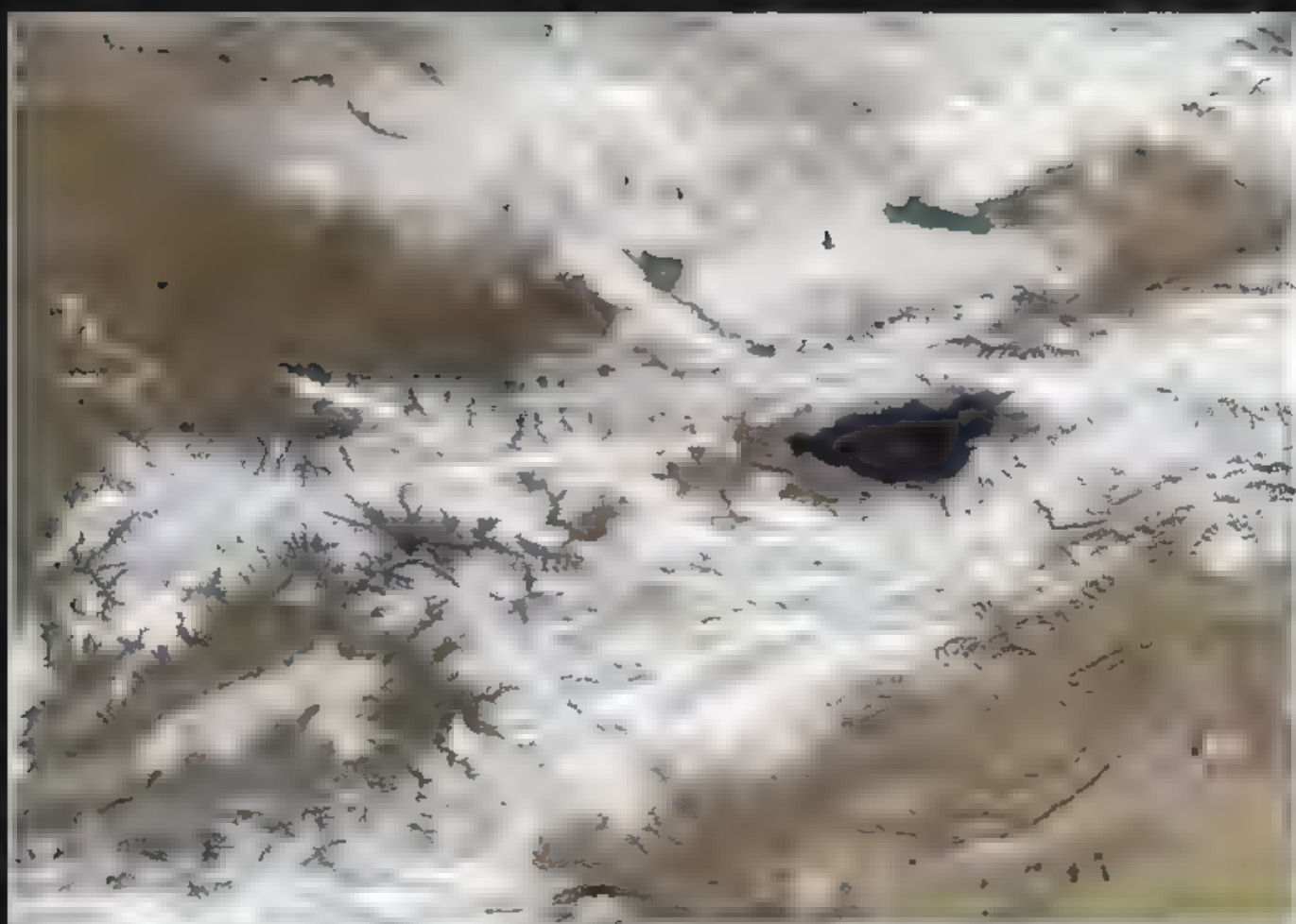
PHOTO: NASA/JESSE ALLEN/ROBERT SIMMON (LARGE)

## Mountains

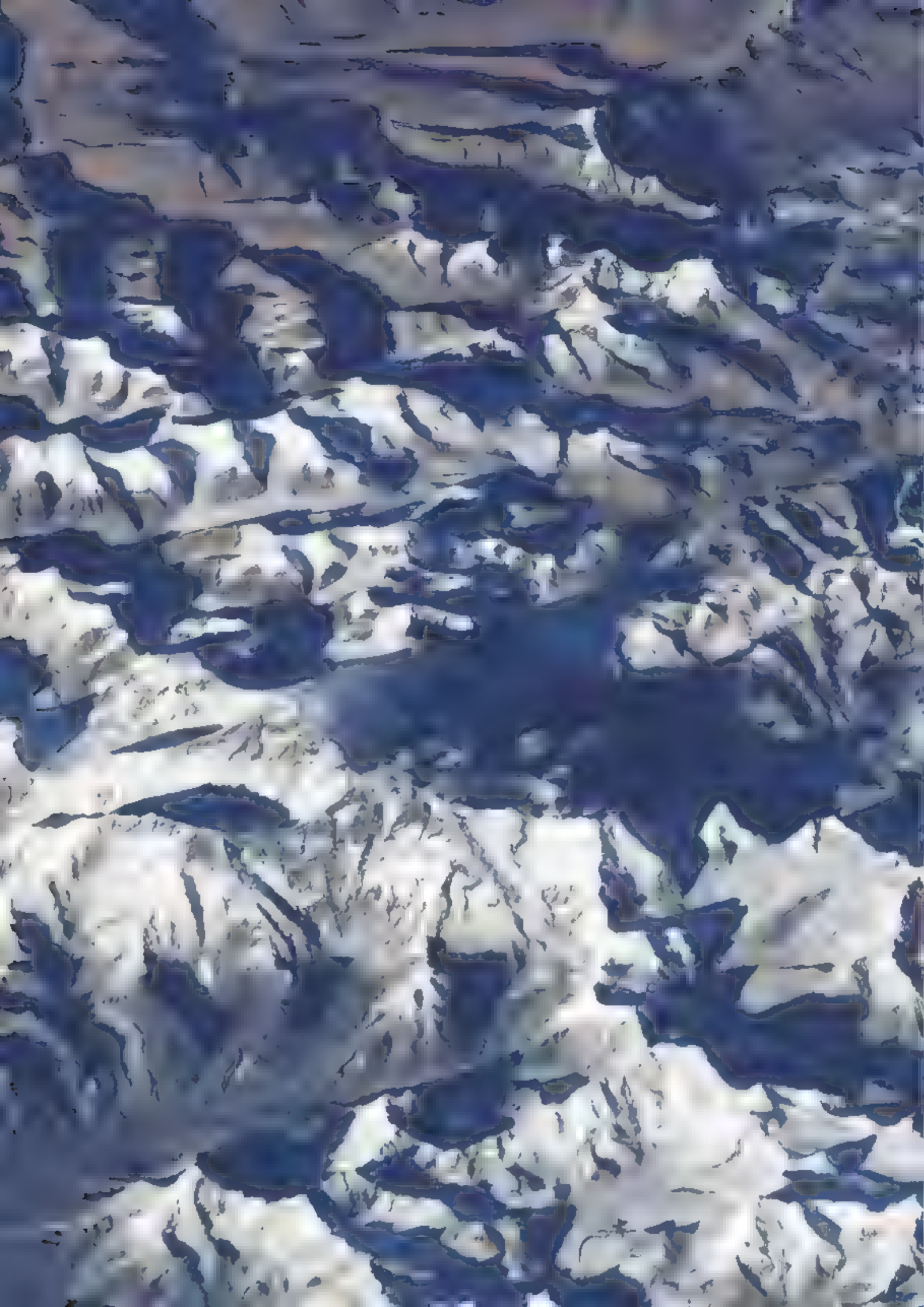
### Kyrgyzstan

SNOW HIGHLIGHTS THE Tian Shan and Pamir Alay mountains that surround Lake Issyk-Kul. Mountains cover 95 per cent of this Central Asian country.

PHOTO: NASA/GSFC/JEFF SCHMALTZ







## Mt. Everest

### Himalayas

WITH OVER 100 mountains exceeding 7200m, the Himalayas are the world's highest mountain range. Topping them all is Mount Everest, at a staggering 8848m – the equivalent height of 1600 stacked London buses.

PHOTO: NASA



# HUMAN IMPACT



The planet has been evolving and changing since before humans existed. However, there can be no doubt of the effect that people have had on Earth's surface. Civilisation, farming and mining are just a few of the activities that have left their mark.

## Gulf of Montijo

Panama

THE SAN PABLO river runs through Panama into the Gulf of Montijo. This image of the ecological transition zone shows the dramatic change in landscape from the protected wetlands surrounding the river to the farms and pastures further out.

PHOTO: NASA/BITREPRESS/HOWELL





## Deforestation 2000

Rondônia, Brazil

► SINCE THE 1970s, the state of Rondônia has undergone rapid change. Initially, areas of the Amazon Rainforest were cleared for roads. Farmers migrated and cleared small areas for crops. Over time the farms grew and industrial scale agriculture became the main reason behind the deforestation.

PHOTO: NASA/ASTER/ROBERT SIMMONS

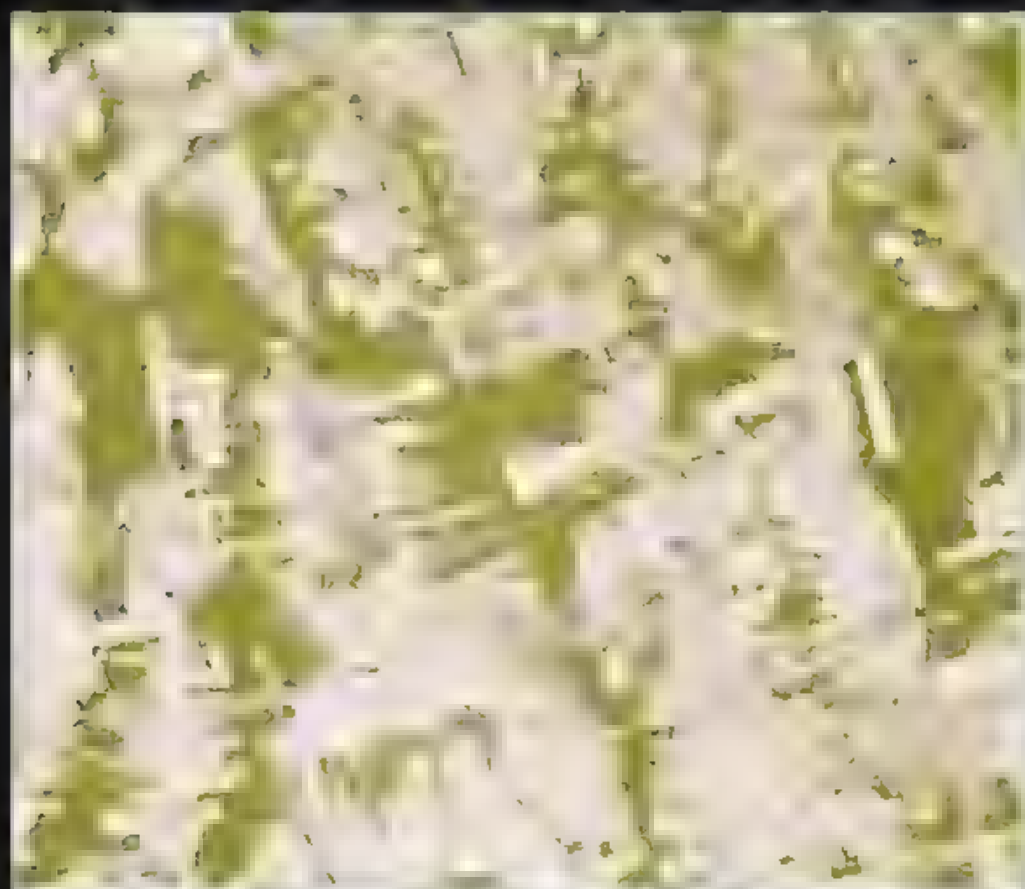


## Deforestation 2006

Rondônia, Brazil

► IN JUST SIX years, Brazil lost nearly 150,000km<sup>2</sup> of forest, an area larger than Greece. Even though the rate of deforestation has decreased, if it maintained its current level, 40 per cent of the Amazon Rainforest will have been destroyed by 2030.

PHOTO: NASA/ASTER/ROBERT SIMMONS





## Harvesting shrimp

Gulf of Fonseca, Honduras  
and Nicaragua

SHRIMP FARMING IS the third largest export from Honduras and is estimated to provide over 18,000 jobs. The green bordered ponds are the shrimp farms. The ponds are bordered by dark green wetlands. PHOTO: NASA/JESSE ATTER/ROBERT SIMON





## Alluvial fan Southern Iran

A SEASONALLY DRY  
river channel carves its  
way through the valleys of  
the Zagros Mountains. Even  
though the surface is dry for  
most of the year, water still

flows at the  
bottom of the mountain, then  
stream loses its speed and  
fans out across the valley.

irrigate the crops.

(PHOTO: NASA/ASTER/JESSE ALLEN)



## San Geronimo Pass Wind Farm

1849



## Gujarat Solar Park

Gujarat, India

◀ ASIA'S LARGEST SOLAR park is being constructed in western India. The park generates two-thirds of India's solar power and is estimated to save 8 million tonnes of carbon dioxide emissions per year.

PHOTO: DIGITALGLOBE

## Solar power

Near Seville, Spain

▼ THE PLANTA SOLAR 20 is the world's most powerful solar power tower. It consists of 1255 mirrors that reflect the solar radiation onto a receiver. This produces steam, which is then converted into electricity.

PHOTO: NASA/GSFC/ASTER





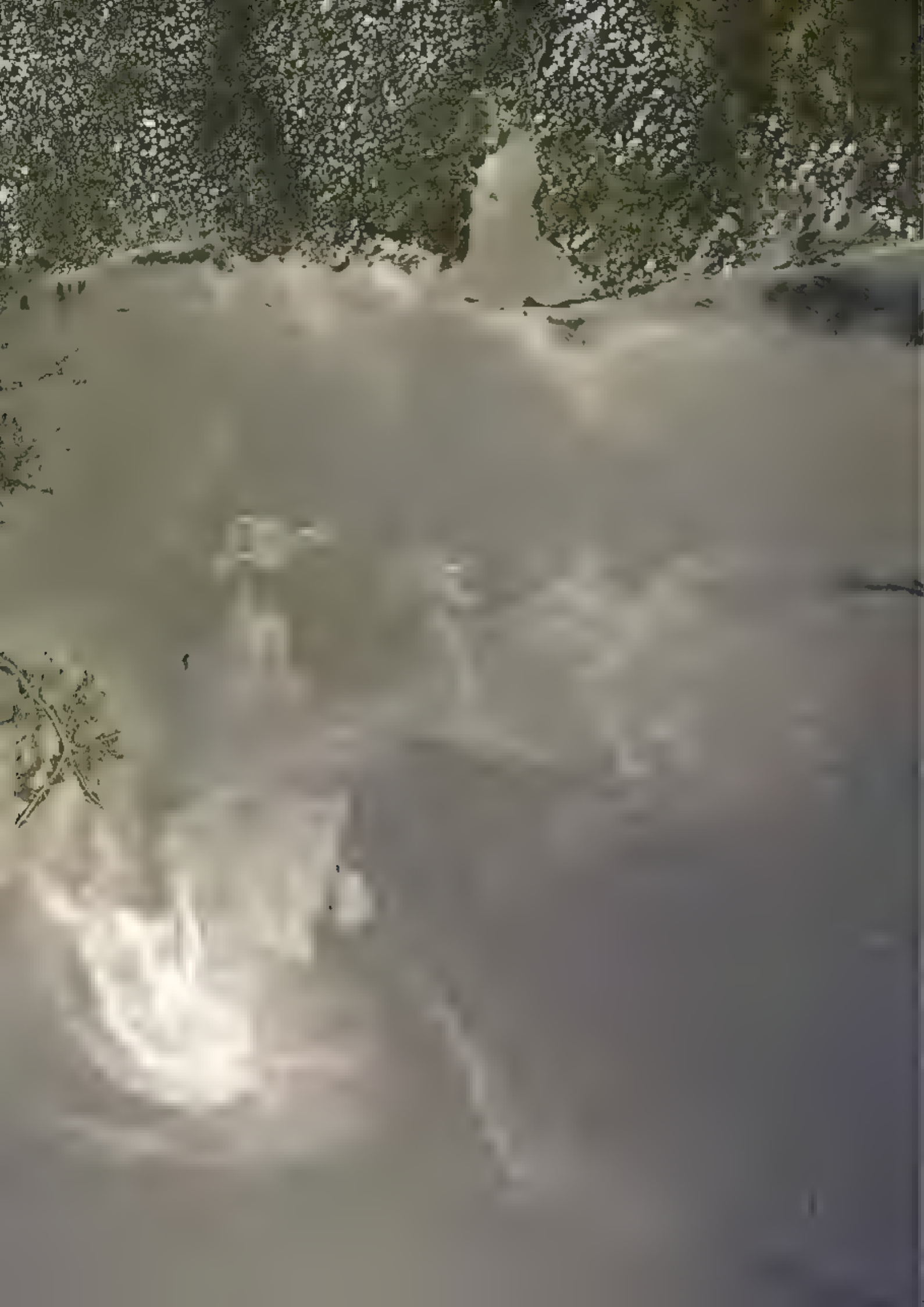
## Deepwater Horizon oil spill

Gulf of Mexico

20 April 2010

THE EXPLOSION OF the Deepwater Horizon oil rig claimed 11 lives and resulted in approximately 774.2 million litres of oil pouring into the Gulf of Mexico for 87 days. It is estimated that 6000 birds, 600 sea turtles and 100 mammals died as a result.

© 2010 BBC Earth. All rights reserved.





## Sunrise Dam Gold Mine

Western Australia

► GOLD WAS DISCOVERED at Sunrise Dam in 1988 and mining began in 1995. Originally, it was an open pit mine, but in 2003 underground mining started as well. Its remote location means miners frequently have to be flown to and from the site.

PHOTO: NASA EO-1 TEAM/JESSE ALLEN

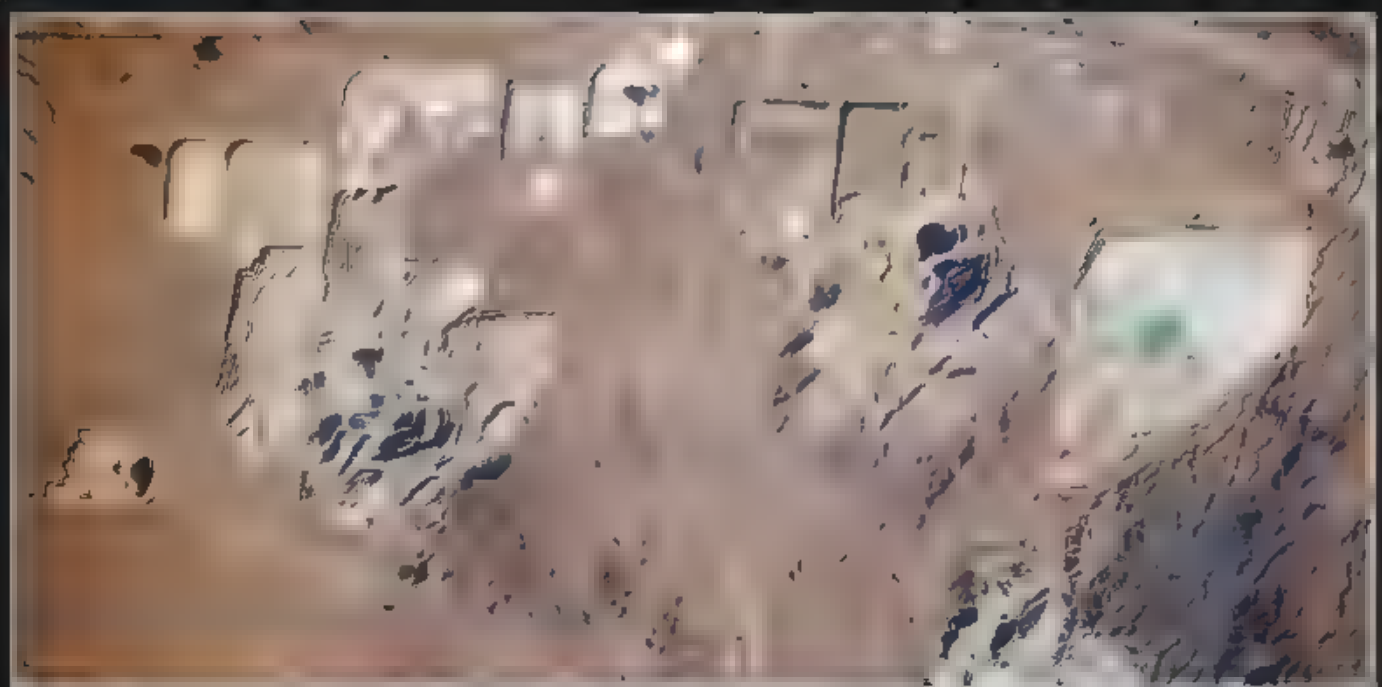


## Open pit mines

Arizona, USA

▼ ARIZONA IS THE United States' largest source of copper. As the mineral deposits are found near the surface, most of the mining is open pit. The Asarco Mission mine, on the left, processes over 48,000 tonnes of ore per day.

PHOTO: NASA/EXPEDITION 22 CREW

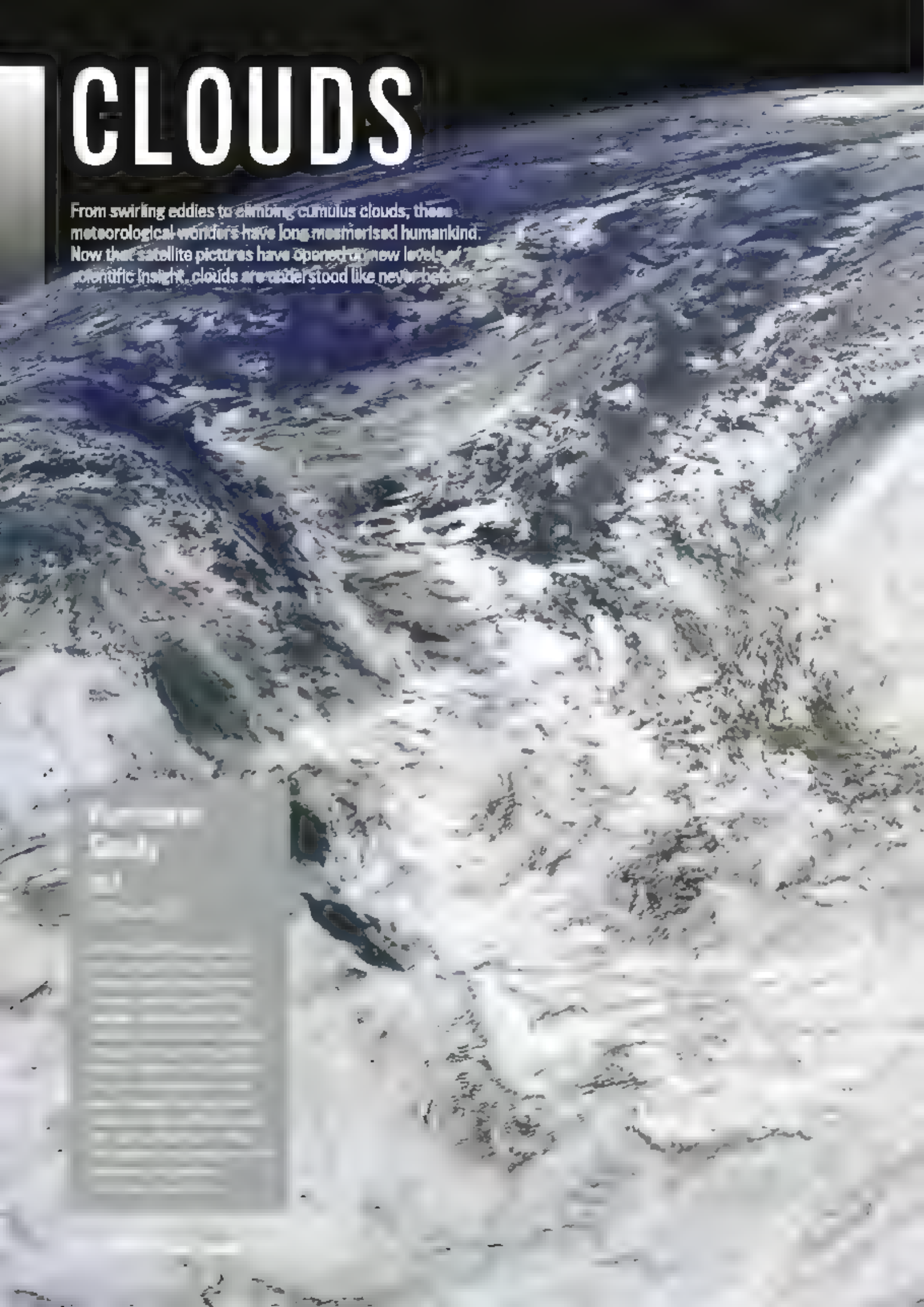


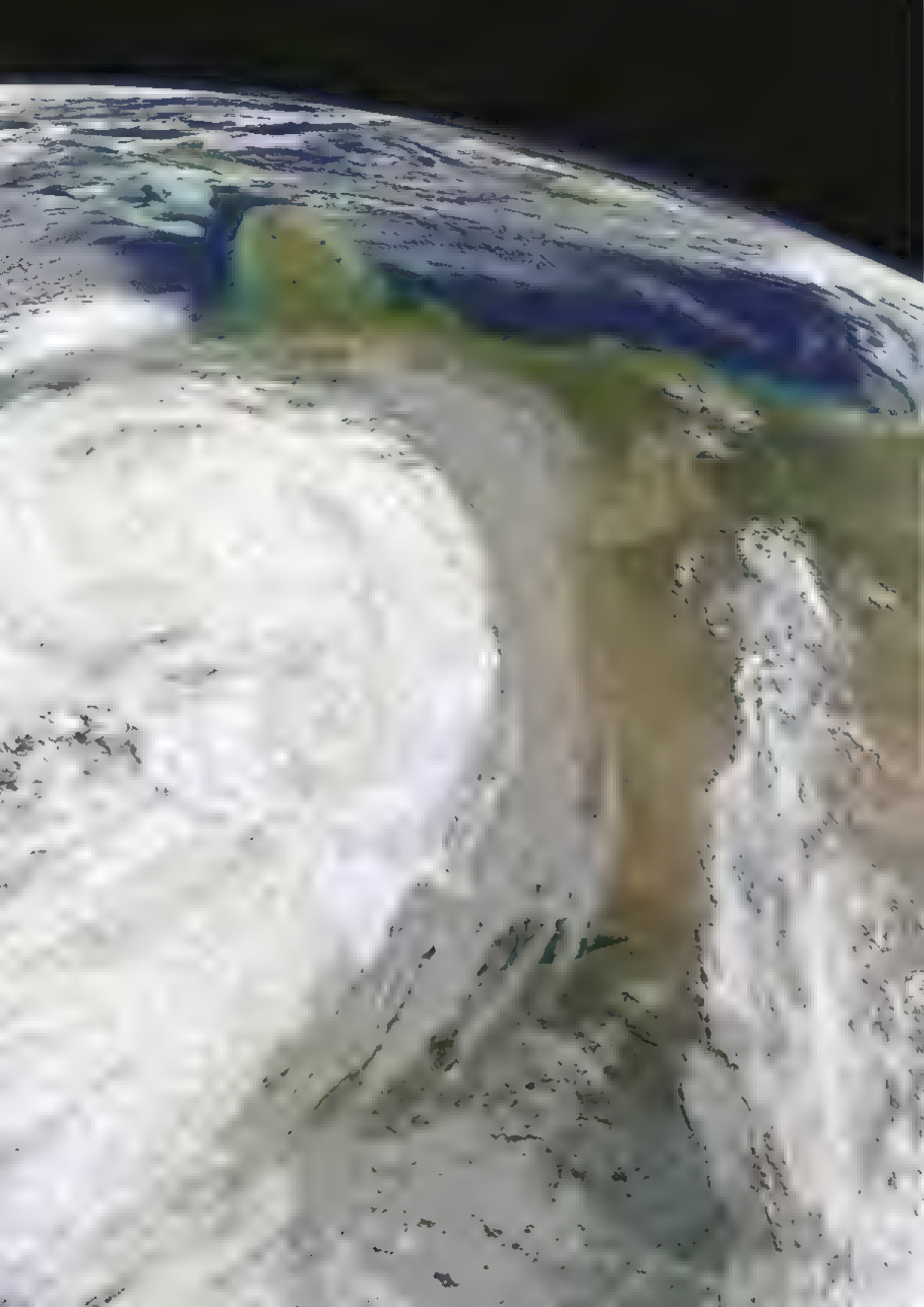




# CLOUDS

From swirling eddies to climbing cumulus clouds, these meteorological wonders have long mesmerised humankind. Now that satellite pictures have opened up new levels of scientific insight, clouds are understood like never before







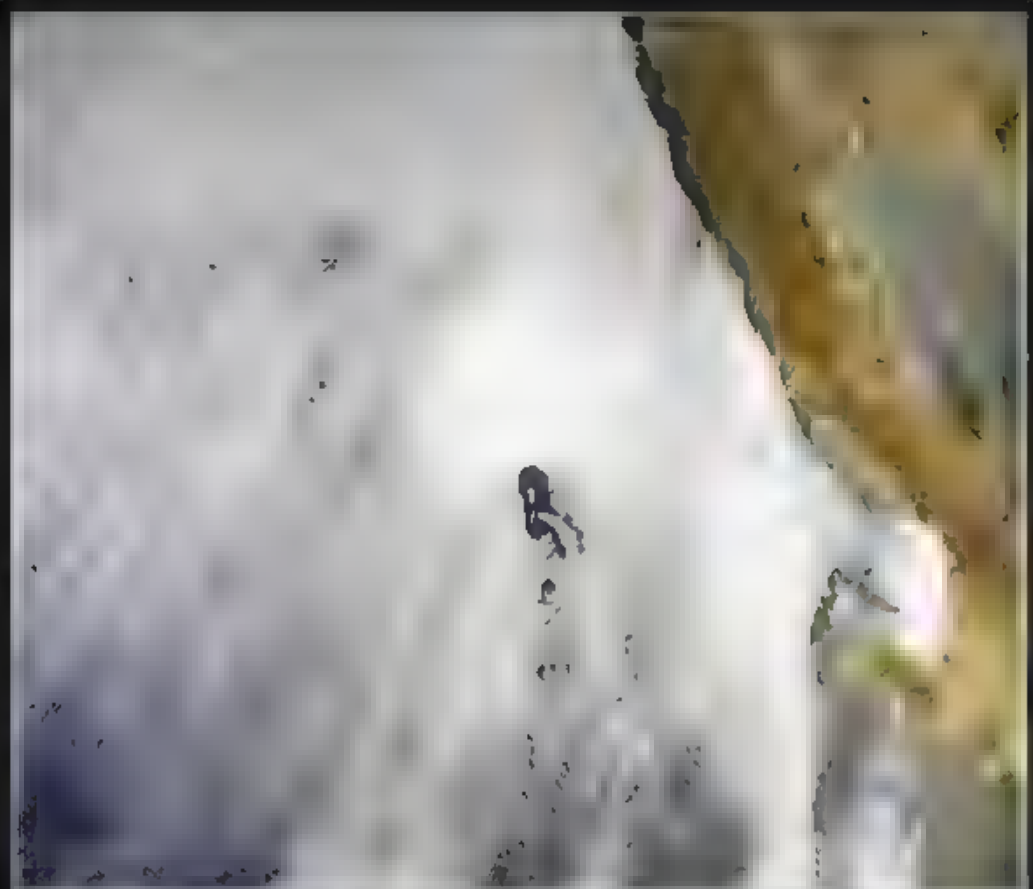
## Stratocumulus clouds

Pacific Ocean

► THE SKY OVER the Pacific – the planet's largest ocean – plays host to many spectacular cloud displays. In the centre of this massive stratocumulus sheet, lie two different phenomena.

Von Karman vortices – spiralling eddies that form in a line – dance about just south of Guadalupe Island. In addition, two faint rainbow-like lines called 'glories' stretch across the cloud.

(PHOTO: NASA/JEFF SCHMALTZ)

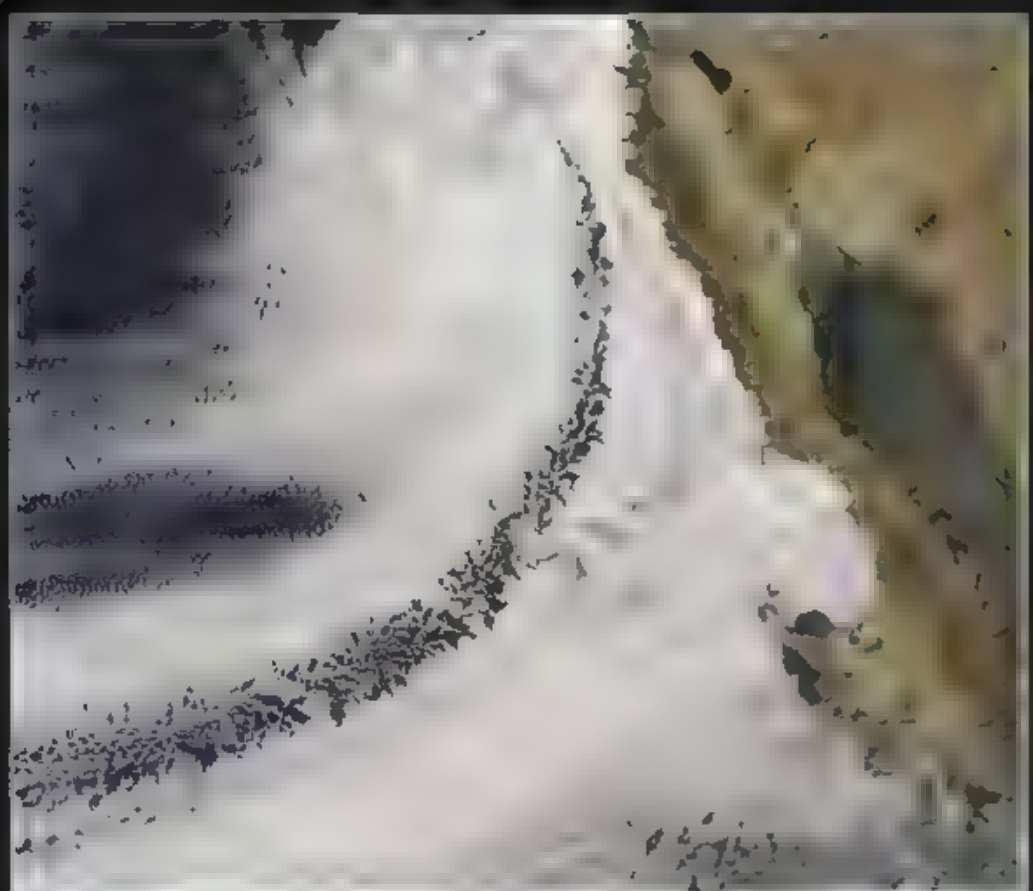


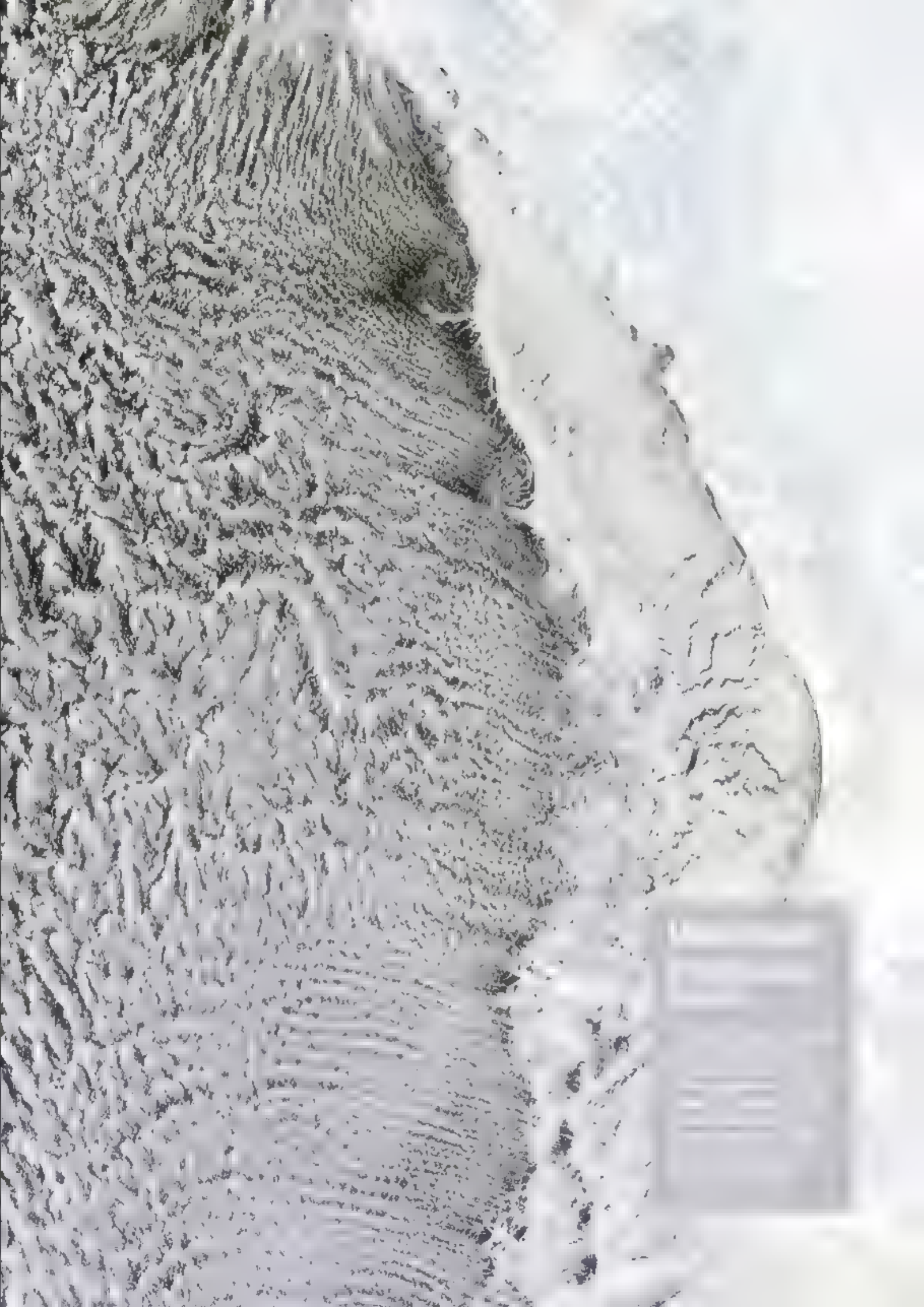
## Ahead of the curve

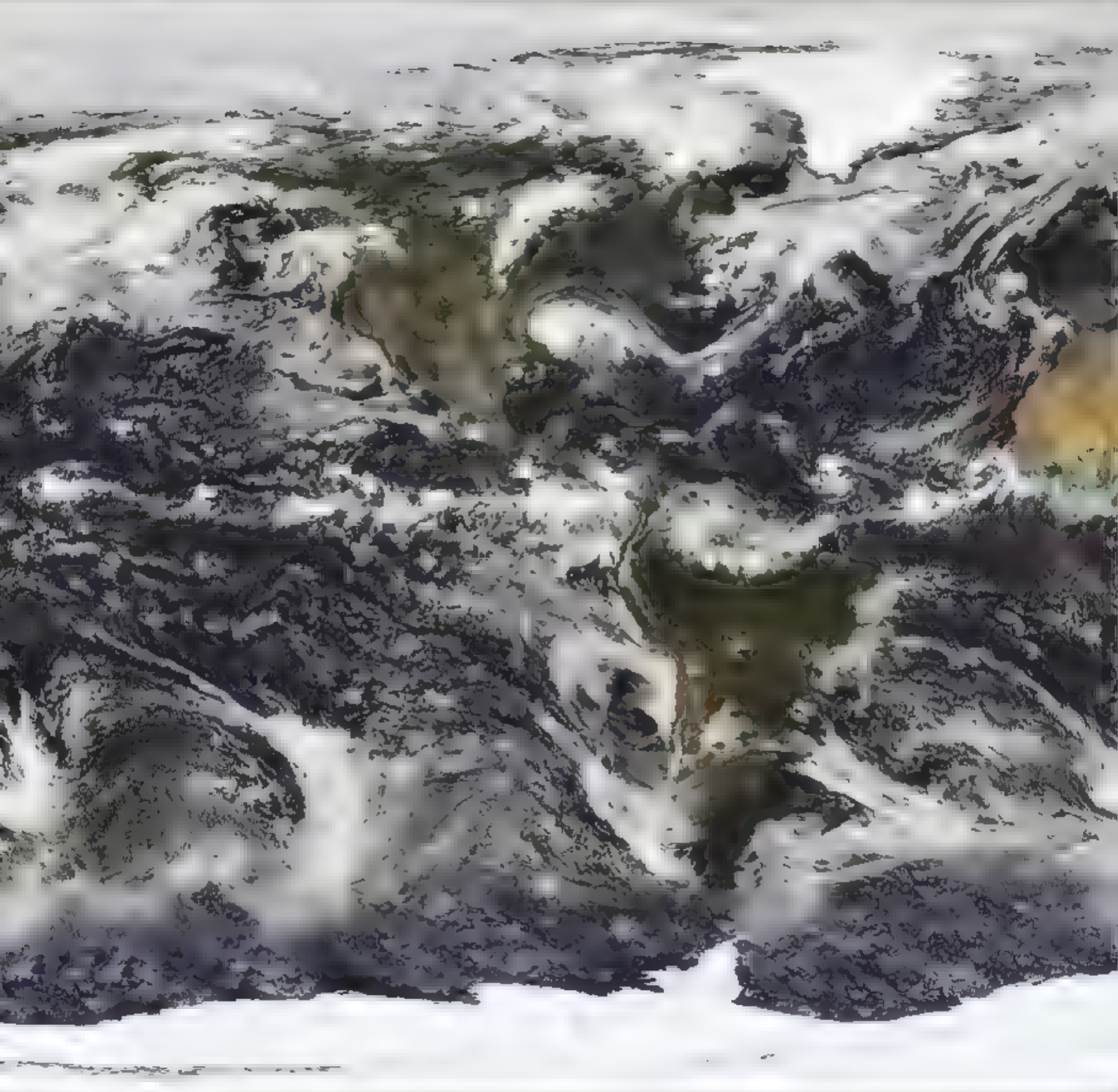
Pacific Ocean

► AGAIN, ABOVE THE Pacific, a sheet of stratocumulus cloud hugs the Baja California Peninsula shoreline. But here, an arc over 1000km long slices through its centre. This curve emerged as the cloud bank parted over San Clemente Island, which lies beneath the thicker area of cloud in the top of the photo.

(PHOTO: NASA/JEFF SCHMALTZ)





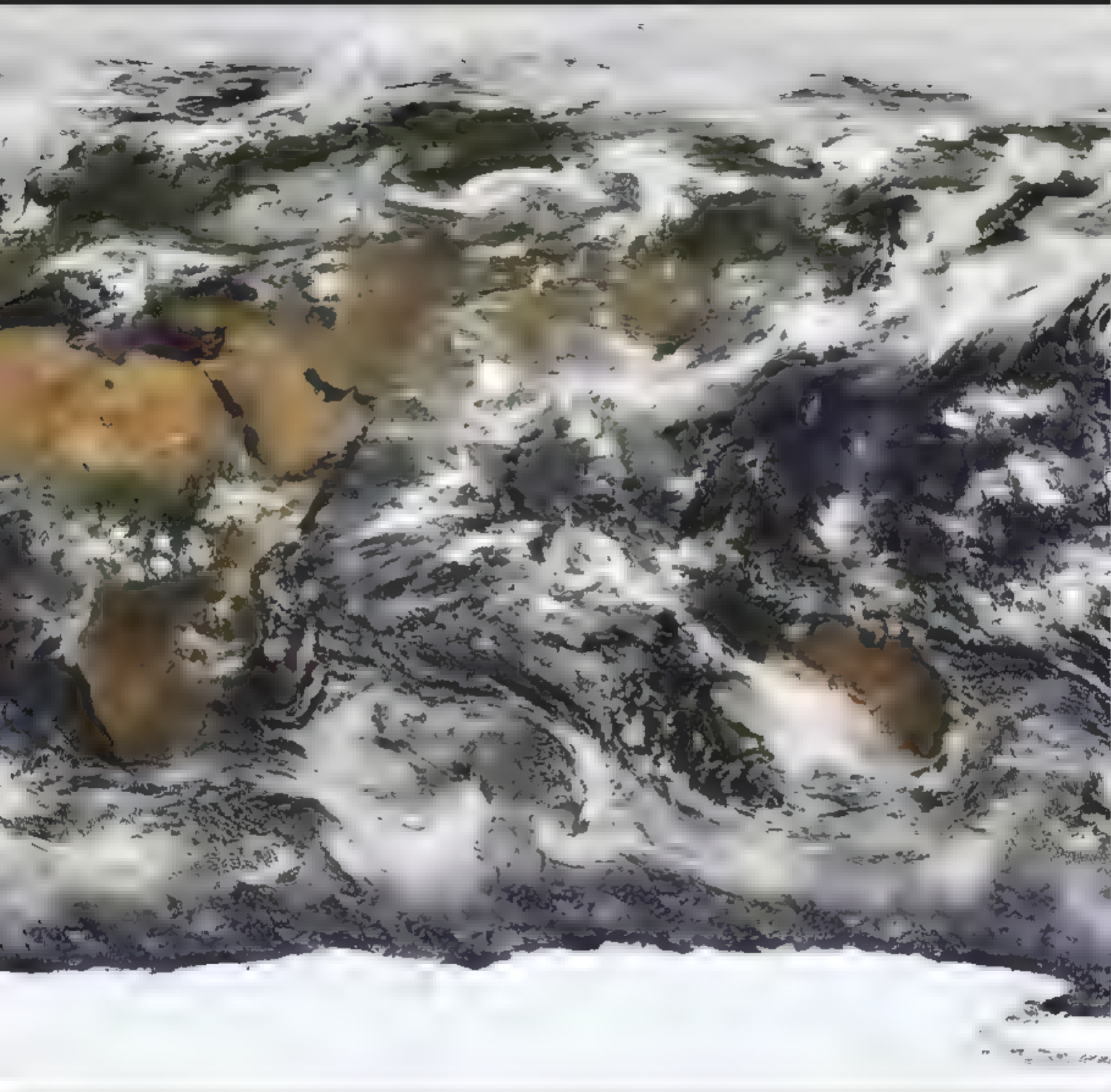



## State of flux

COMPOSED FROM SEVERAL different satellites' observations, this image shows that Earth's atmosphere is in constant circulation. Air rises at hot points around the equator and sinks where it cools. As land masses interrupt its flow and different weather fronts collide, clouds alter and intertwine in complex, ever-changing movement.

PHOTO: NASA/MARIT JENTOF-JENSEN/ROBERT SIMMON





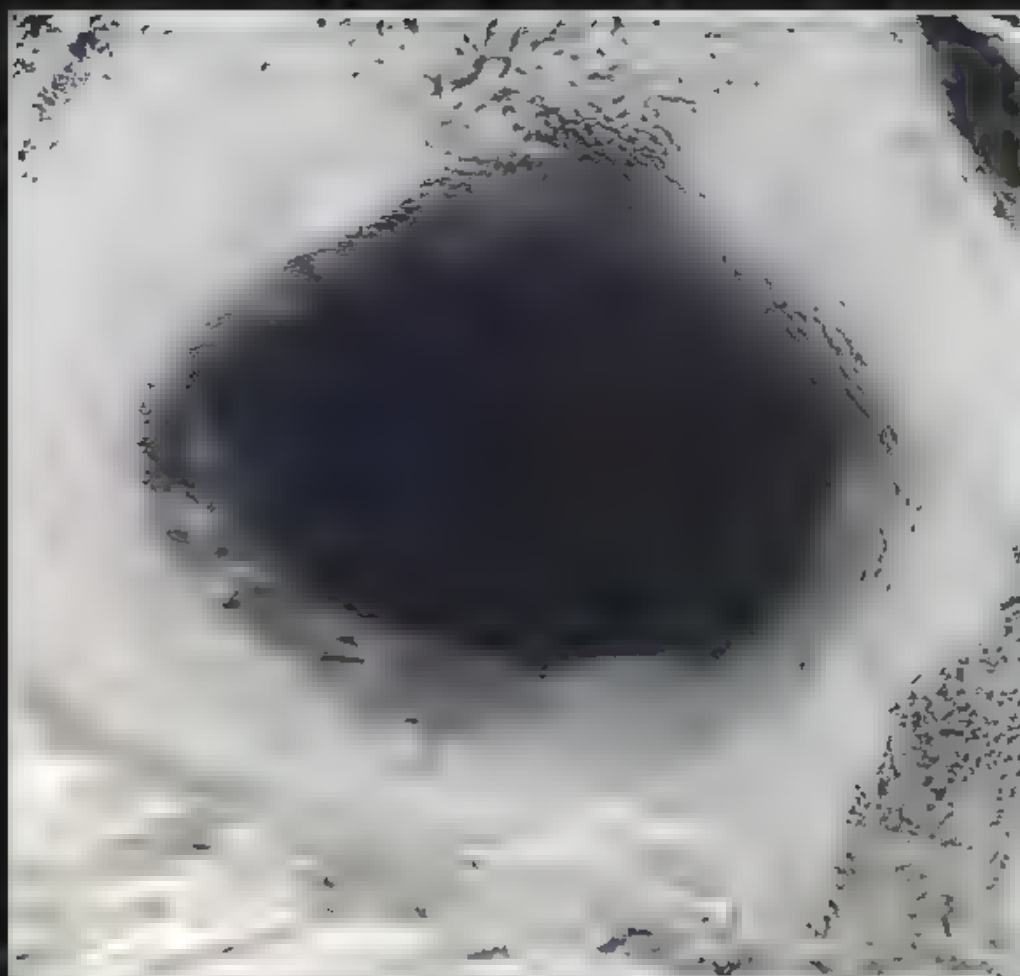


## Hurricane Katrina

Gulf of Mexico

28 August 2005

AS THIS CYCLONE whips up waters over the Gulf of Mexico, a deceptively pure white spiral of cloud forms above. Making its move toward New Orleans, gusts of 280km/h circumnavigate Katrina's clearly defined eye, with storm-force winds stretching out to 370km away. When Katrina reaches Louisiana, it will claim over 1300 lives.



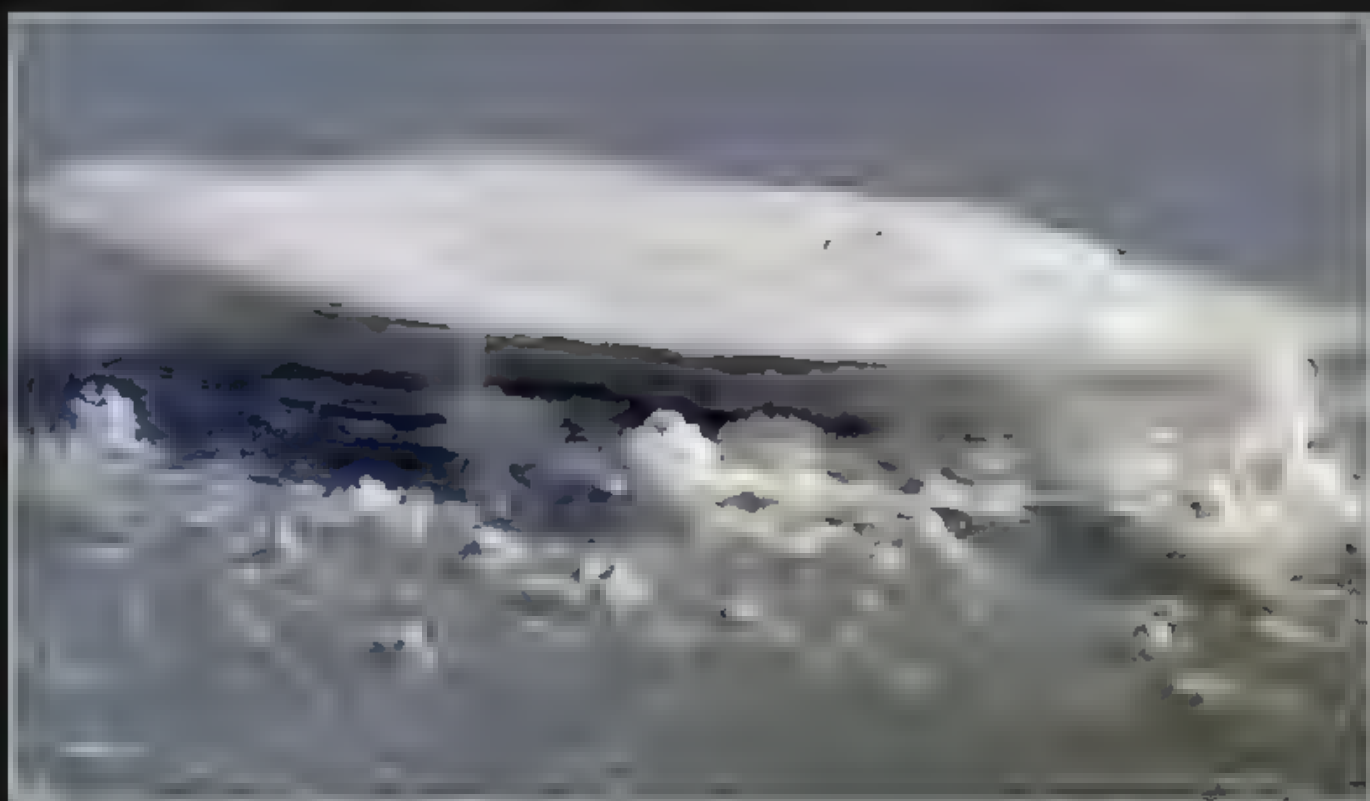
## Pressure point Tasmania, Australia

◀ OFF THE WEST coast of Tasmania, a high-pressure system creates this spectacular chasm in the clouds. Over 1000km wide, this oval-shaped hole has been carved out as high pressure forces a pocket of air to sink down through the stratocumulus cloud blanket.

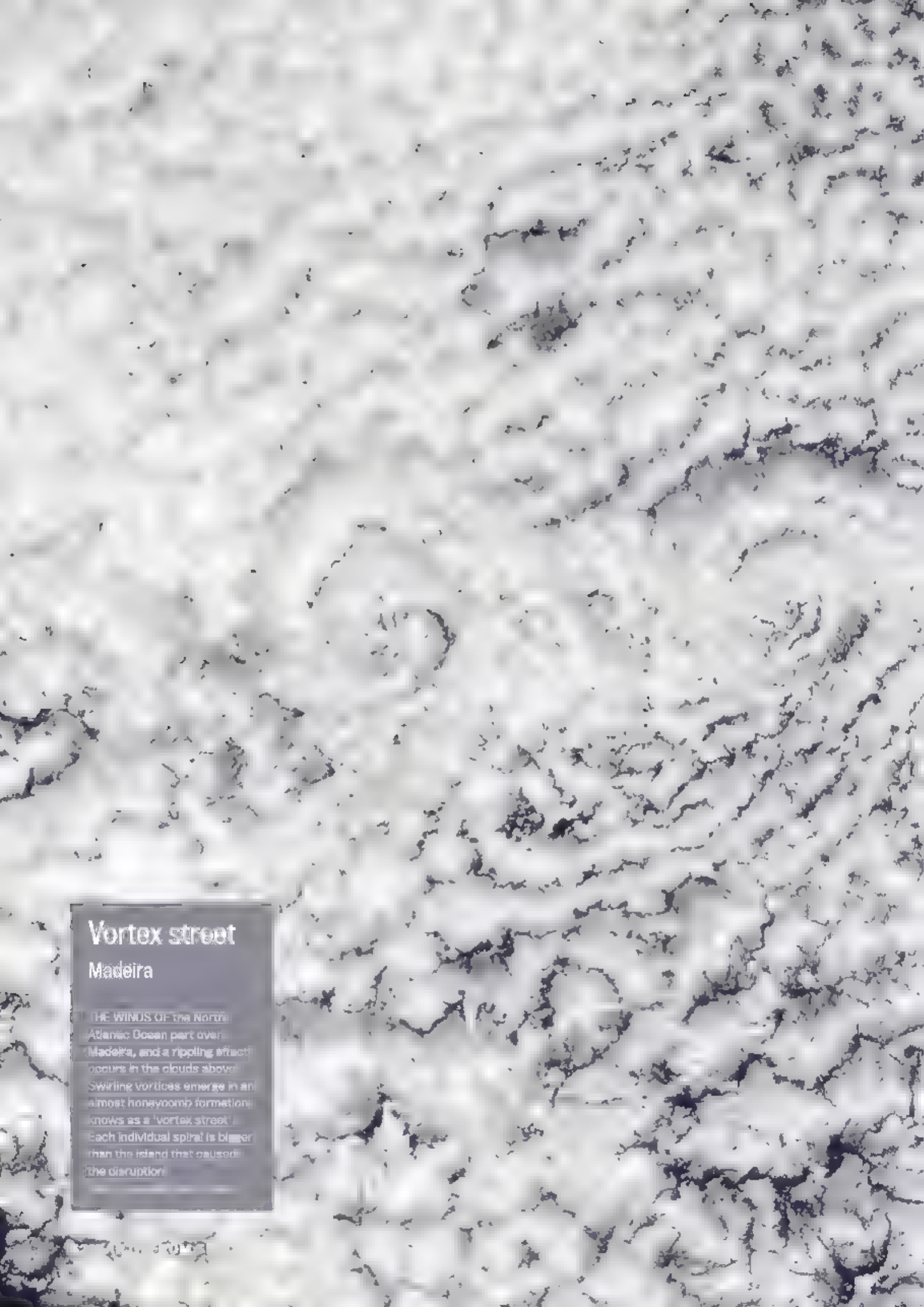
## High and dry Senegal and Mali

▼ A CUMULONIMBUS CLOUD towers over the African sky in this image taken from the International Space Station. As the massive cloud expands vertically, it meets a dry layer of the atmosphere that obstructs its rise. The still-growing cloud is forced to spread out, developing a distinct anvil shape.

PHOTO: NASA/EXPEDITION 16 CREW



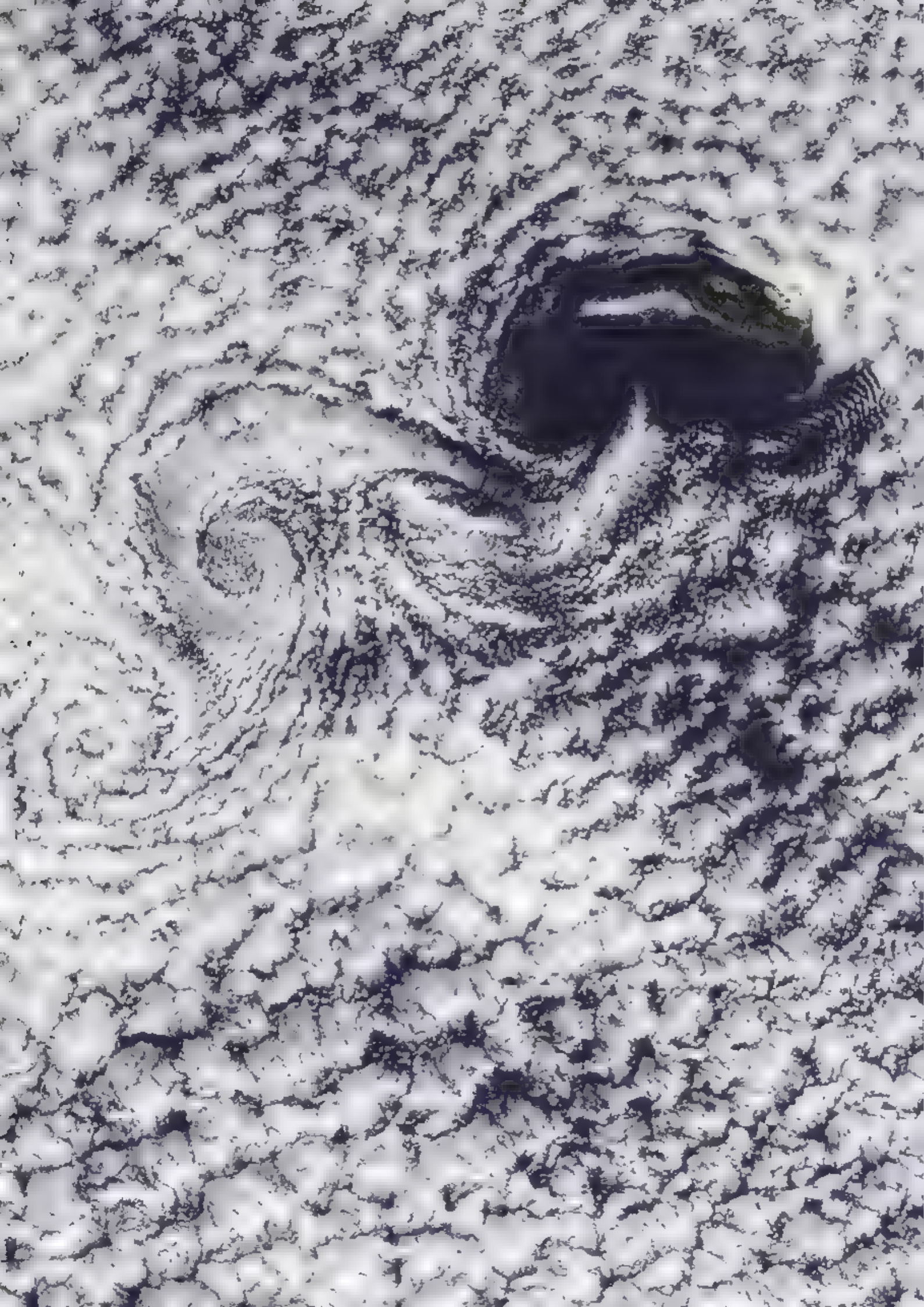




## Vortex street

### Madeira

THE WINDS OF the North Atlantic Ocean part over Madeira, and a rippling effect occurs in the clouds above. Swirling vortices emerge in an almost honeycomb formation, known as a 'vortex street'. Each individual spiral is bigger than the island that caused the disruption.



## On the horizon

### Pacific Ocean

► EVER WONDERED WHAT a sunset looks like from the International Space Station? As the Sun sinks, huge anvil-topped thunderclouds cast long shadows over the Pacific and a golden pool of reflected sunlight appears in the sea.

PHOTO: NASA/EXPEDITION 7 CREW

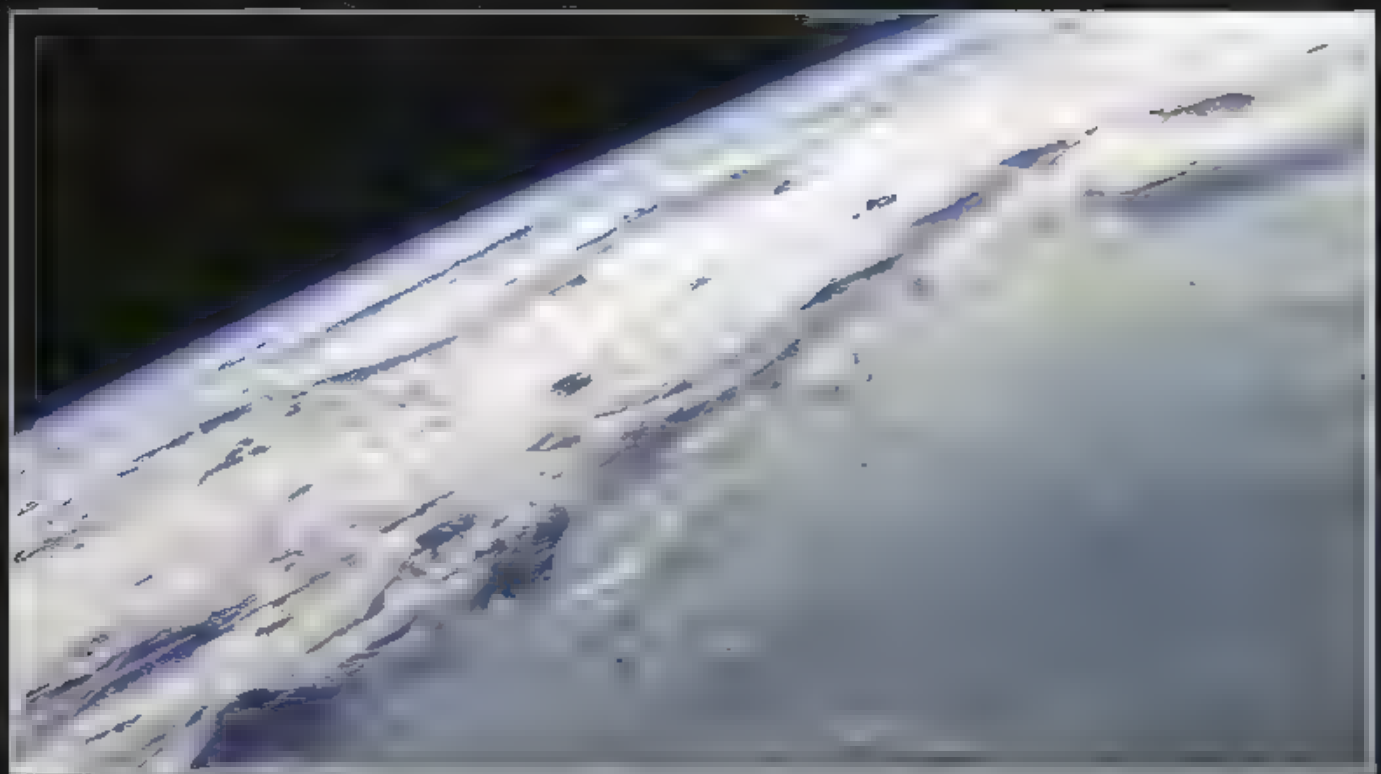


## Thunderstorms

### Brazil

▼ A PICTURESQUE ROW of storm clouds rain down over the Amazon, forming circular patterns. The cumulonimbus clouds' arc-like structures reveal that they're near the end of their cycles – soon their centres will collapse entirely.

PHOTO: NASA/GOES PROJECT





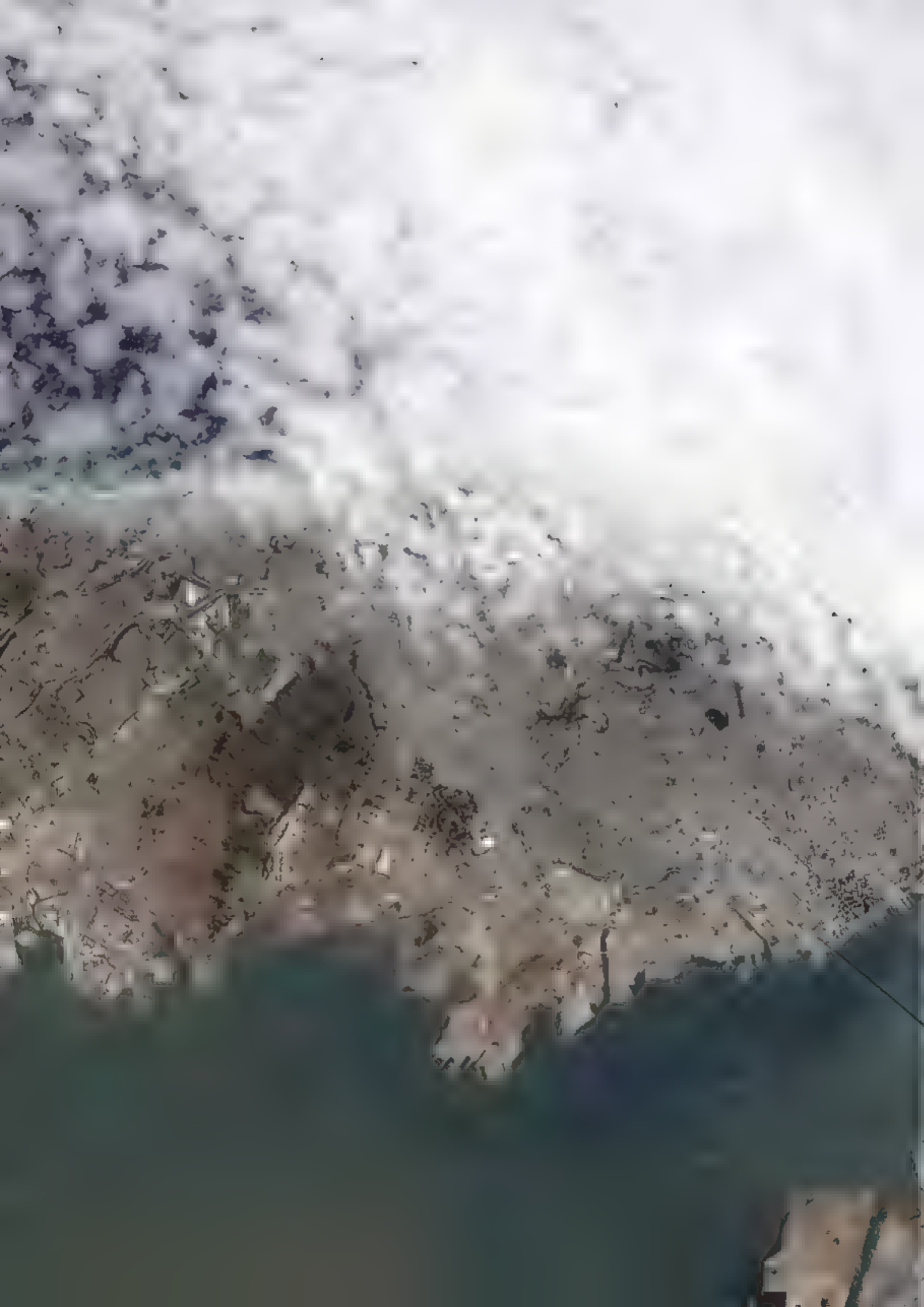


## Wave clouds

Amsterdam Island

THIS TINY VOLCANIC island in the Indian Ocean has the power to make waves in the clouds. As moist and dry layers of air move in turn over the remote volcano's summit, they react differently - the moist air forms lenticular clouds, while the dry air does not - creating a wave-like pattern in the skies above.

PHOTO: NASA/GBPO/JEFF SCHWALTZ



# CITIES

In 1800, only three per cent of the world's inhabitants lived in a city. Today, there are more than 400 cities with a population over one million and half the global population is city-based.

## San Francisco

USA

FOG IS A common sight for all San Franciscoans, especially in summer. Cold air blows in from the Pacific Ocean, colliding with the warm Californian air and forming fog. San Francisco is the second most densely populated city in the USA, with 8632 people per km<sup>2</sup>.

PHOTO: NASA EO-1 TEAM



## CITIES

### Venice

Italy

▼ FAMED FOR ITS gondolas, the Grand Canal is the main thoroughfare in Venice, snaking through the centre of the city. The white dashes on this image are boats transporting people around. Founded in the fifth century, Venice is spread over 118 islands, linked by canals and more than 400 bridges.

PHOTO: NASA/ROBERT SIMMONI

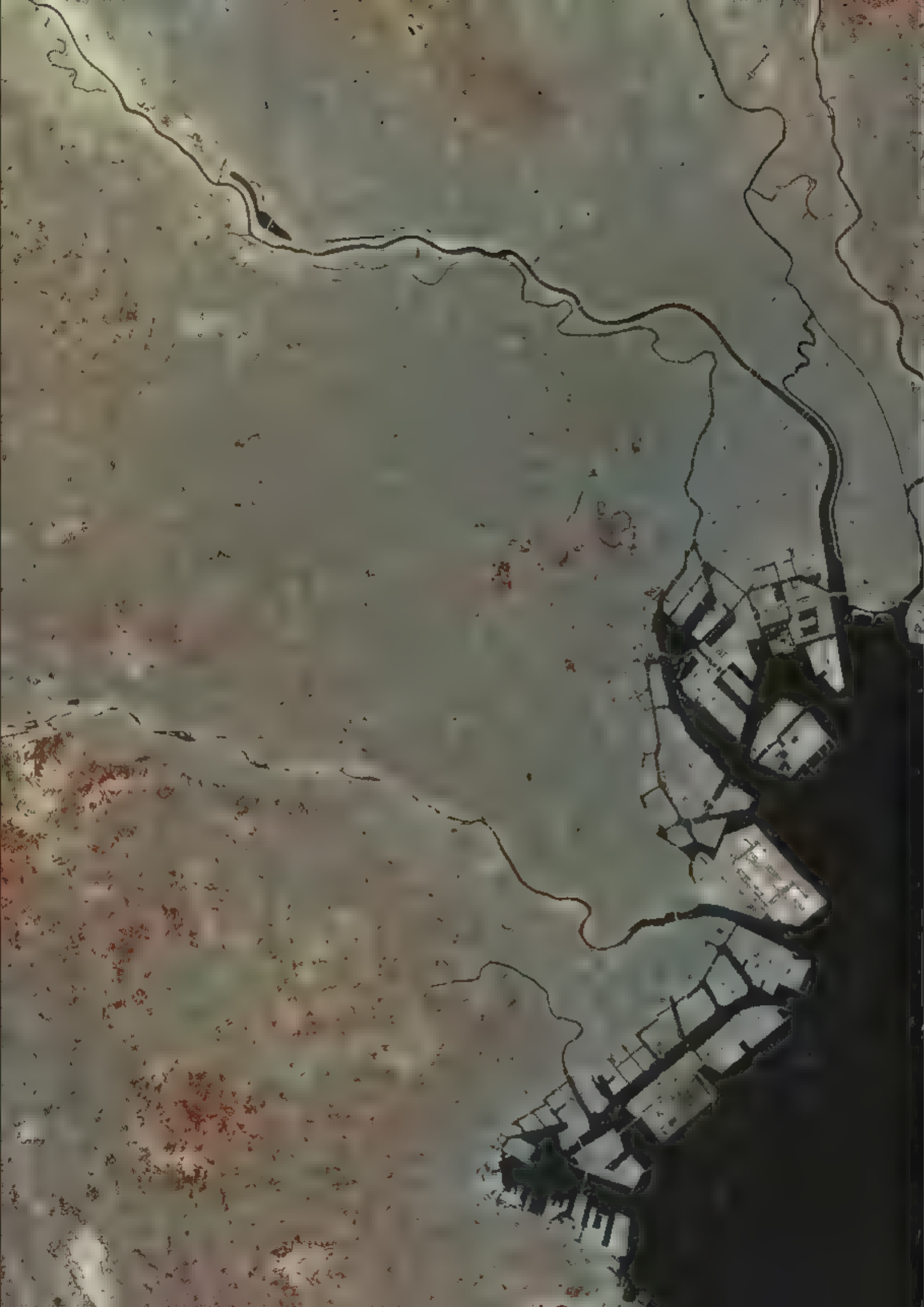
### Tokyo

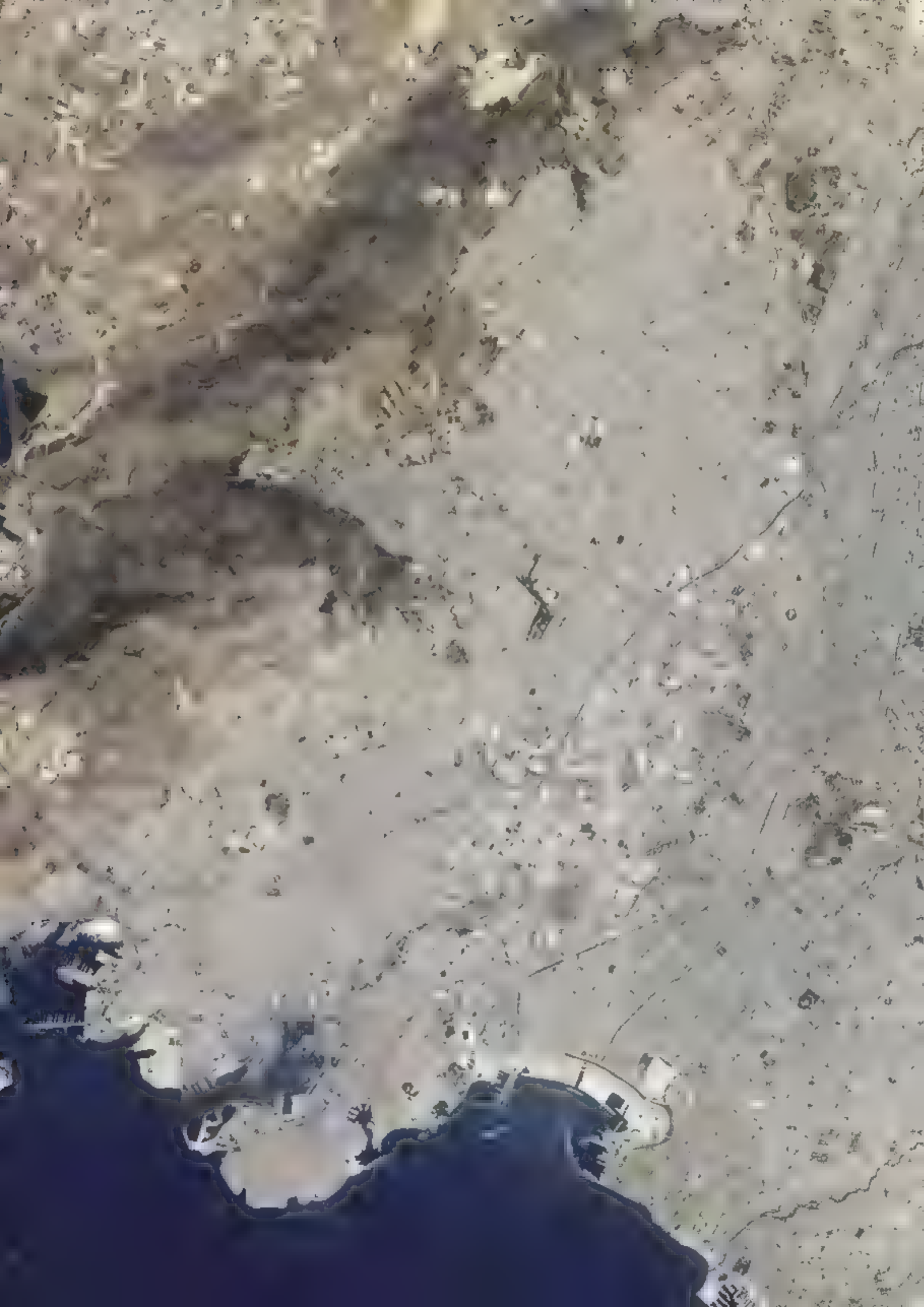
Japan

► ORIGINALLY A SMALL fishing village, Tokyo has grown into a metropolis with a population of 13.2 million. It increases by 2.5 million during the day as workers and students commute into the city. However, the population is expected to halve by 2100 as over 45 per cent of Tokyo's residents are past retirement age.

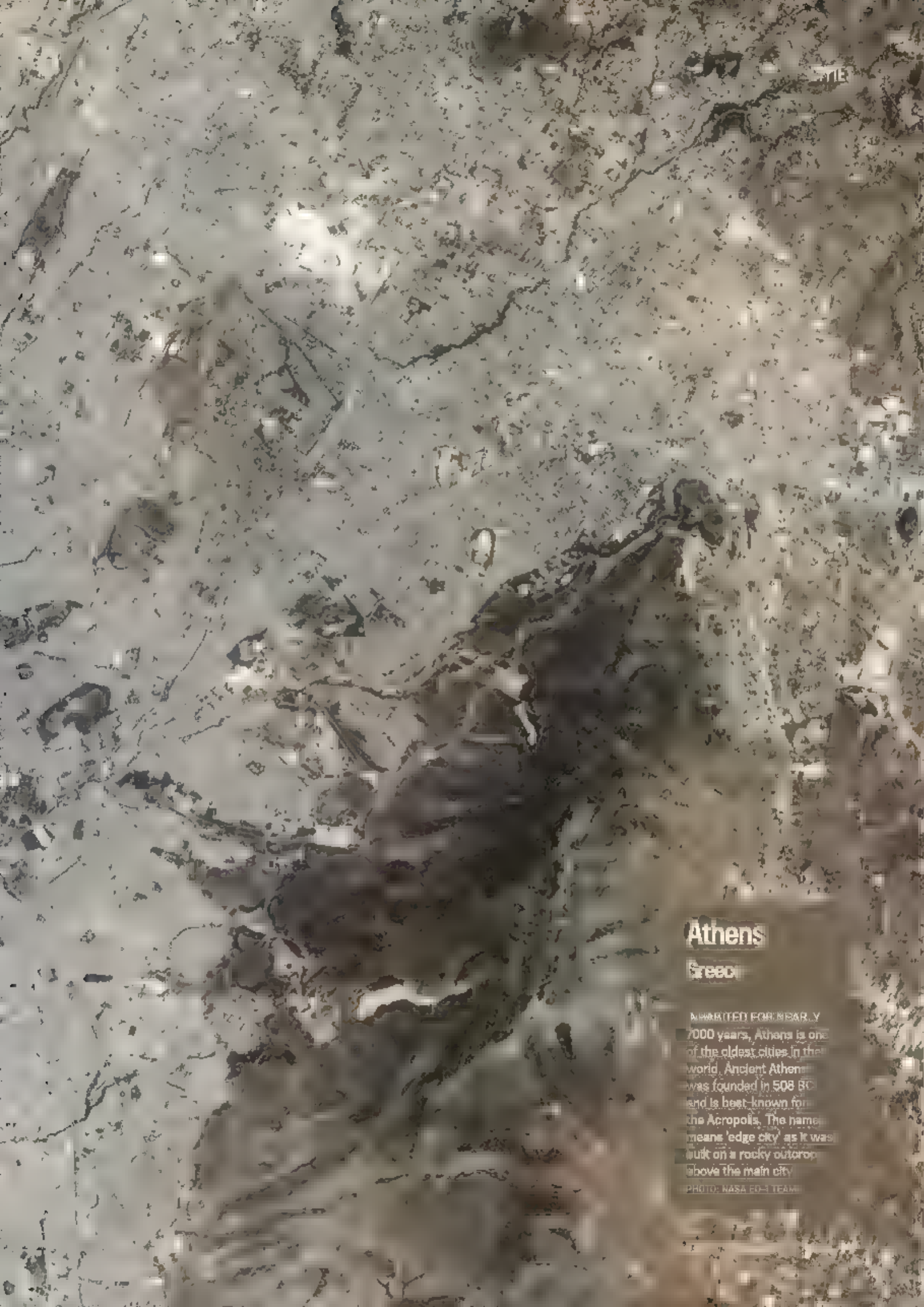
PHOTO: NASA/GSFC/ASTER











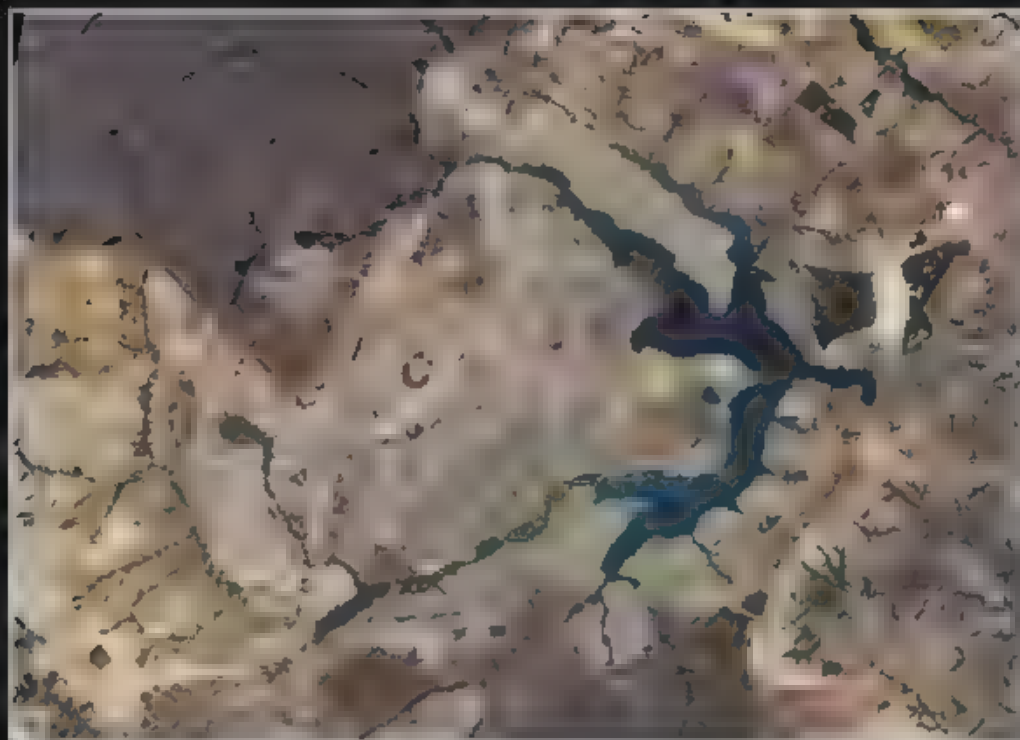
## Athens

Greece

INHABITED FOR NEARLY 7000 years, Athens is one of the oldest cities in the world. Ancient Athens was founded in 508 BC and is best known for the Acropolis. The name means 'edge city' as it was built on a rocky outcrop above the main city.

PHOTO: NASA EO-1 TEAM





## Brasilia

Brazil

◀ BUILT IN 1956 and designed to look like an airplane, Brasilia is the largest city founded in the 20th Century. However, even though it's the capital, Brasilia is only the fourth largest city in Brazil.

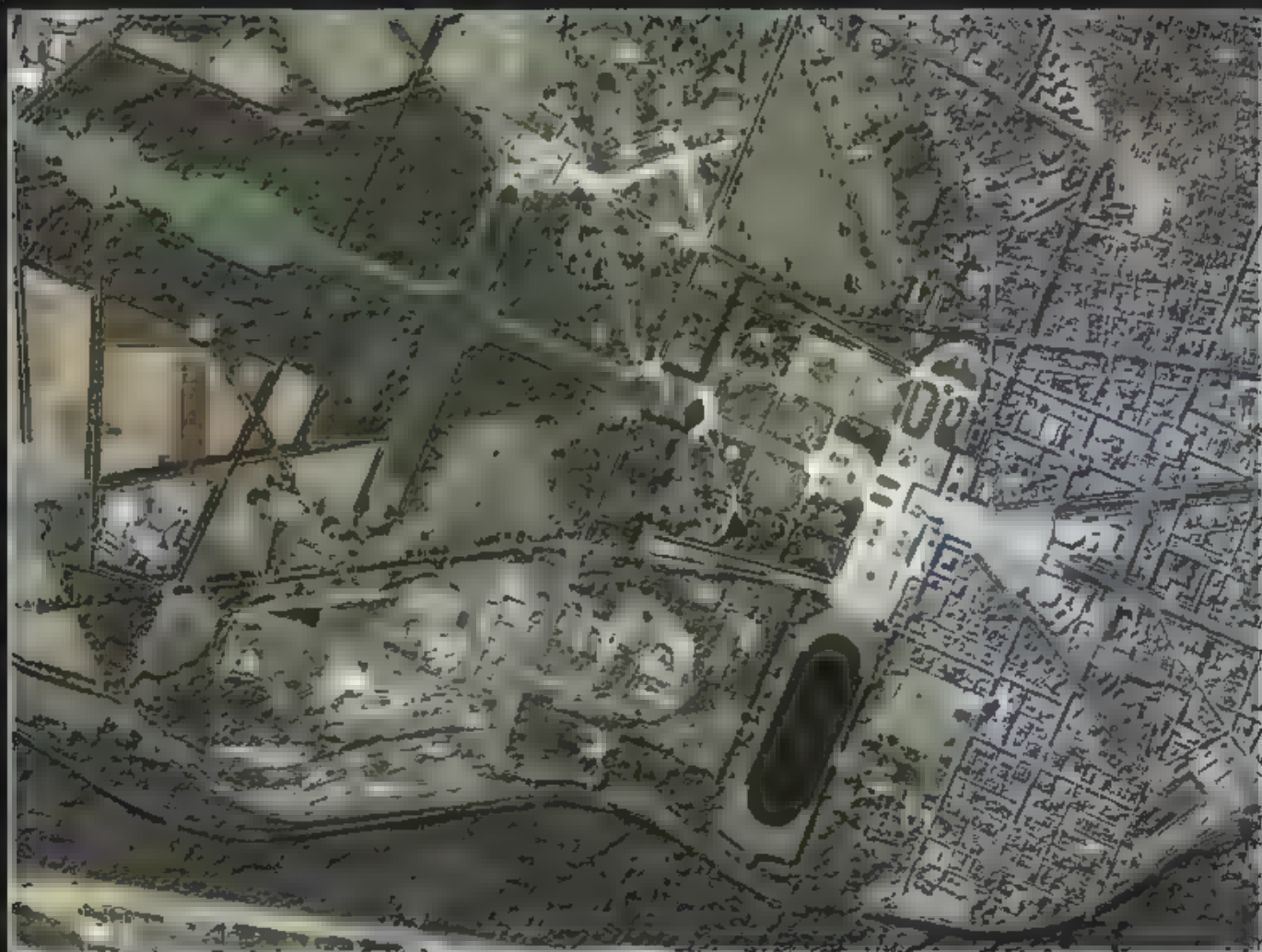
PHOTO: NASA EO-1 TEAM

## Versailles

France

▼ WITH OVER 2000 rooms, the Palace of Versailles dominates the surrounding Parisian suburb. The gardens were designed in the 17th Century and completed before the French Revolution.

PHOTO: DIGITALGLOBE/GETTY





## El Paso and Juárez

USA and Mexico

▼ FROM ABOVE, EL Paso and Juárez seem to be one city. Rio Grande, running diagonally across the image, is the border separating the USA and Mexico. In this false-colour image, vegetation is shown in red. The brightest shades are in El Paso, showing parks and gardens sustained by residents, in contrast with the barren land surrounding the cities.

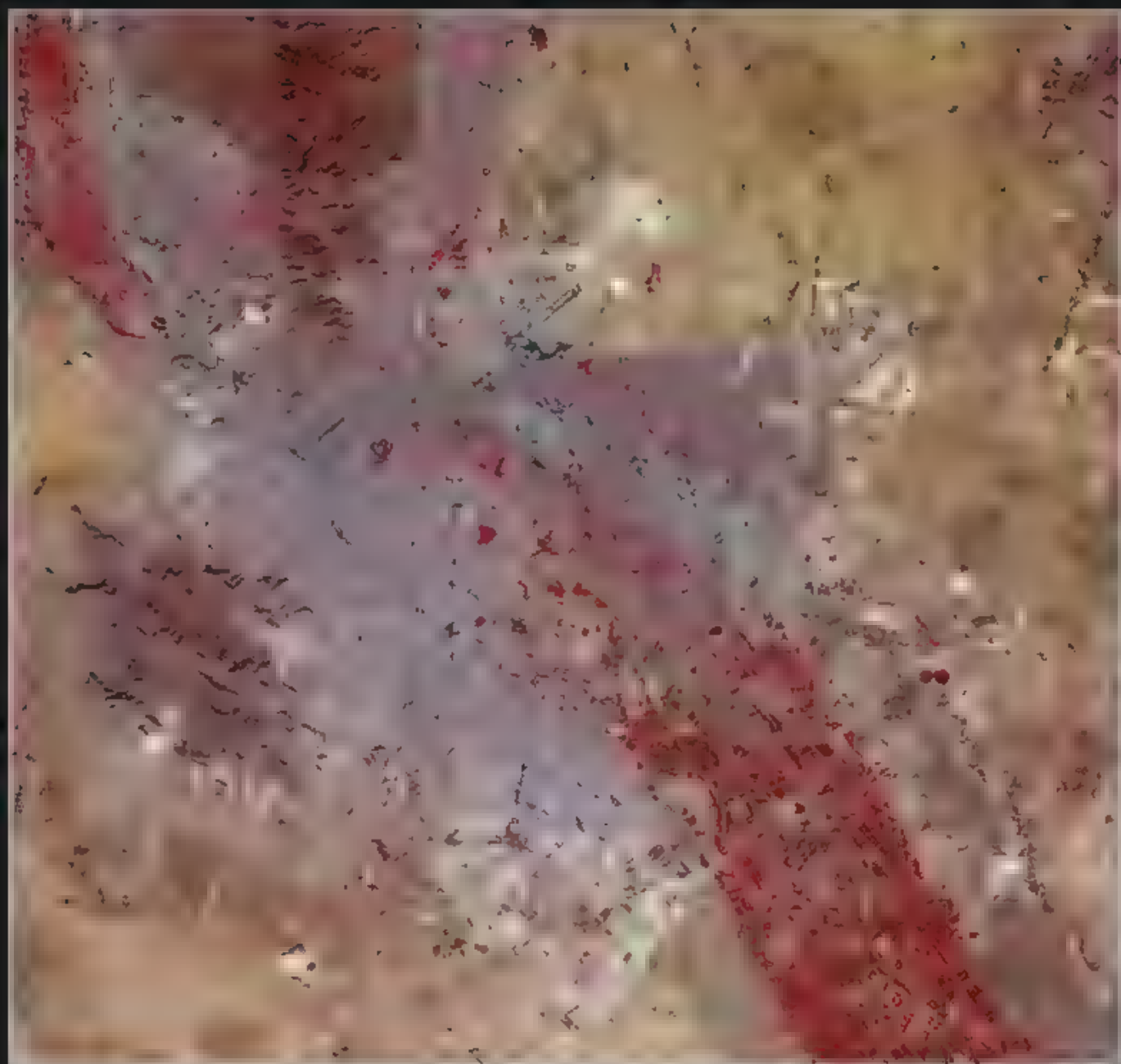
PHOTO: NASA/GSFC/ASTER

## Karachi

Pakistan

► 'CITY OF LIGHTS', as it's also known, is the largest city in Pakistan. The oldest buildings are in the centre and a street grid system covers the rest of the city. Mangrove forests in the Arabian Sea bring some greenery to the otherwise heavily built up city.

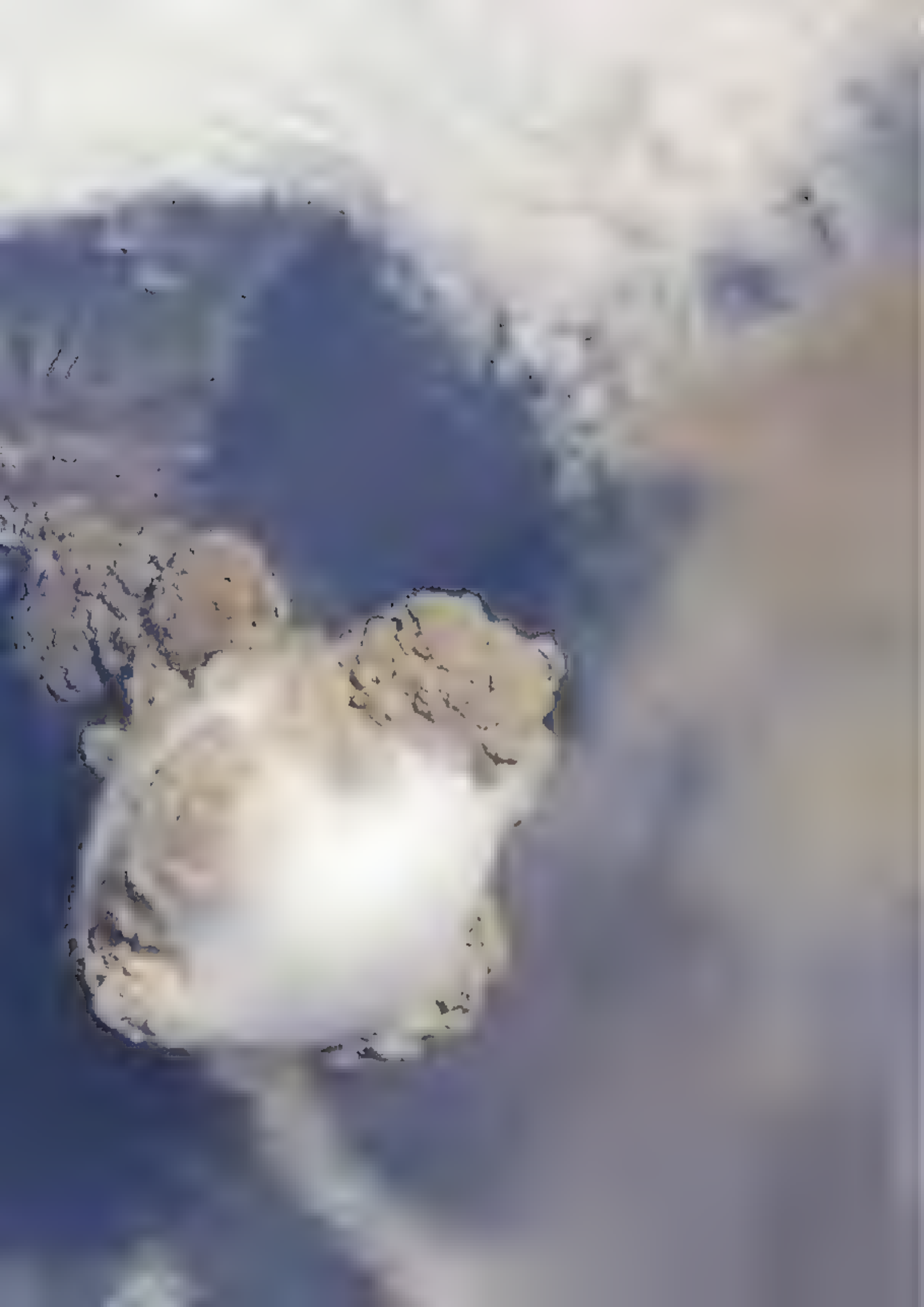
PHOTO: NASA EO-1 TEAM











## Grand Prismatic Spring

Yellowstone Park, USA

► THE THIRD LARGEST hot spring in the world, this geothermal pool can reach up to 87°C. Its vivid colours come from bacteria and algae that thrive in the warm, mineral-rich water.

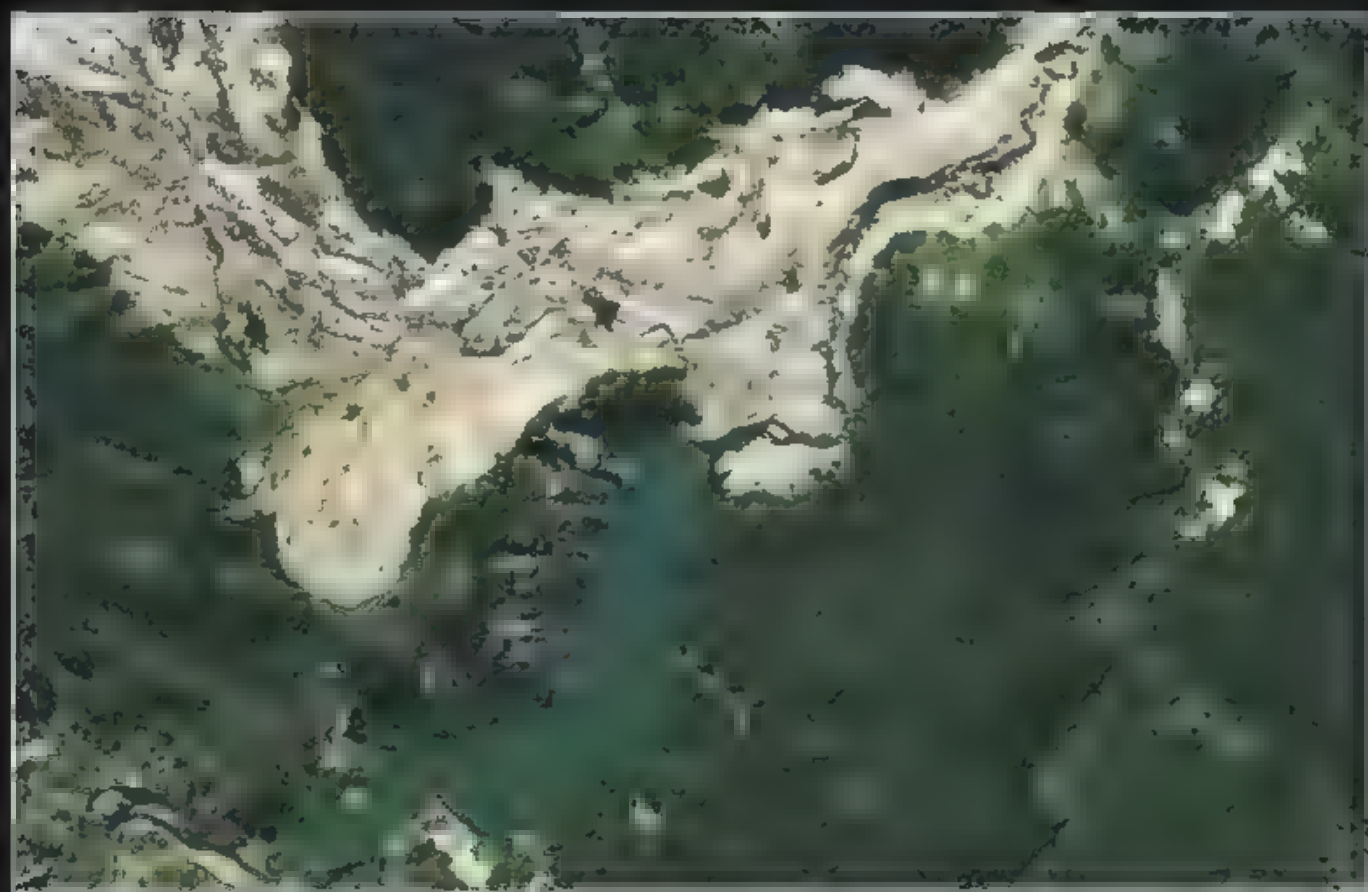
PHOTO: DIGITALGLOBE/GETTY

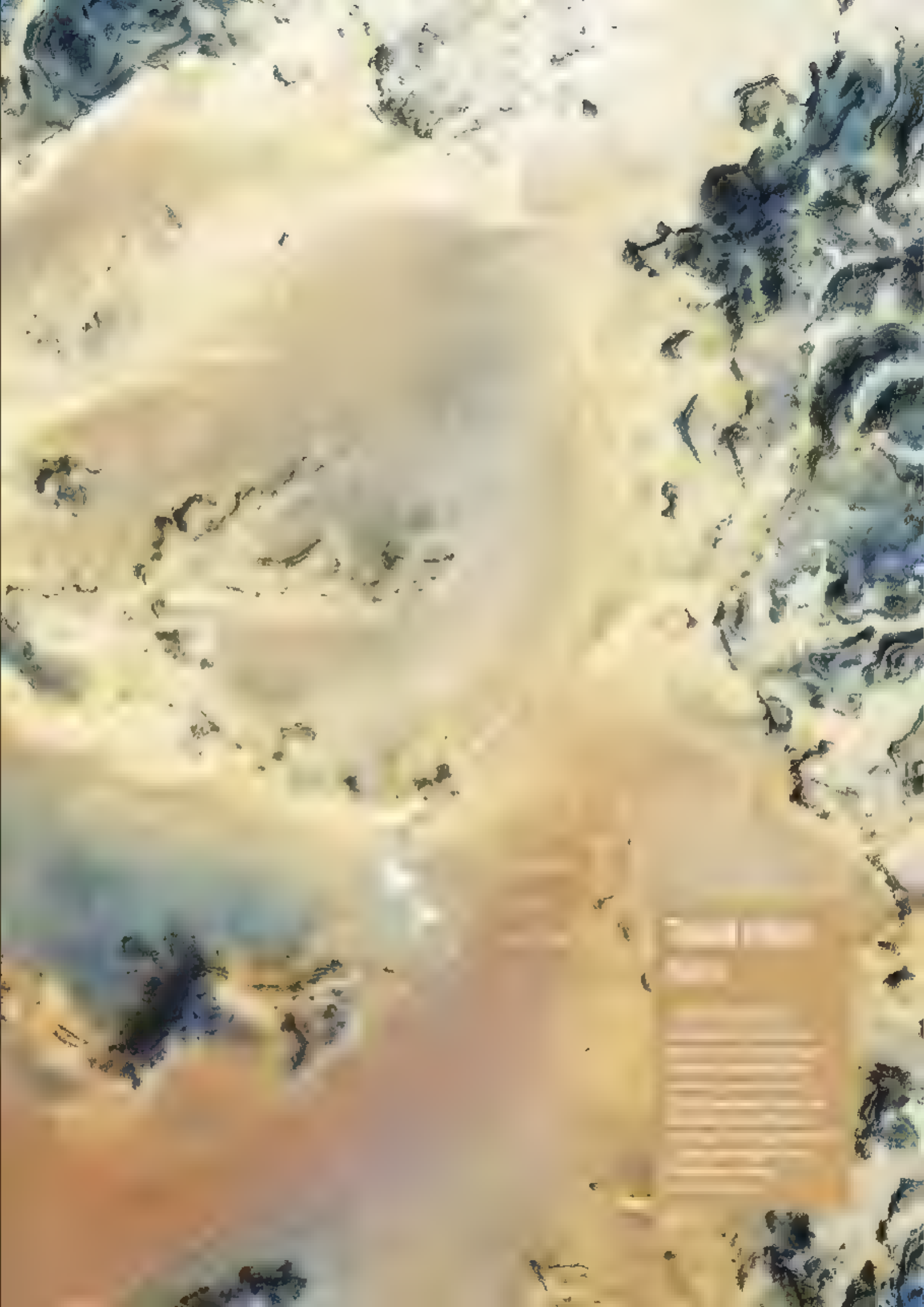
## Valley of Geysers

Kamchatka, Russia

▼ DISCOVERED IN 1941, this remote basin contains around 90 geysers, as well as hot springs. Several years ago, a massive landslide inundated the valley, covering half of the geysers and causing a natural lake to form.

PHOTO: DIGITALGLOBE







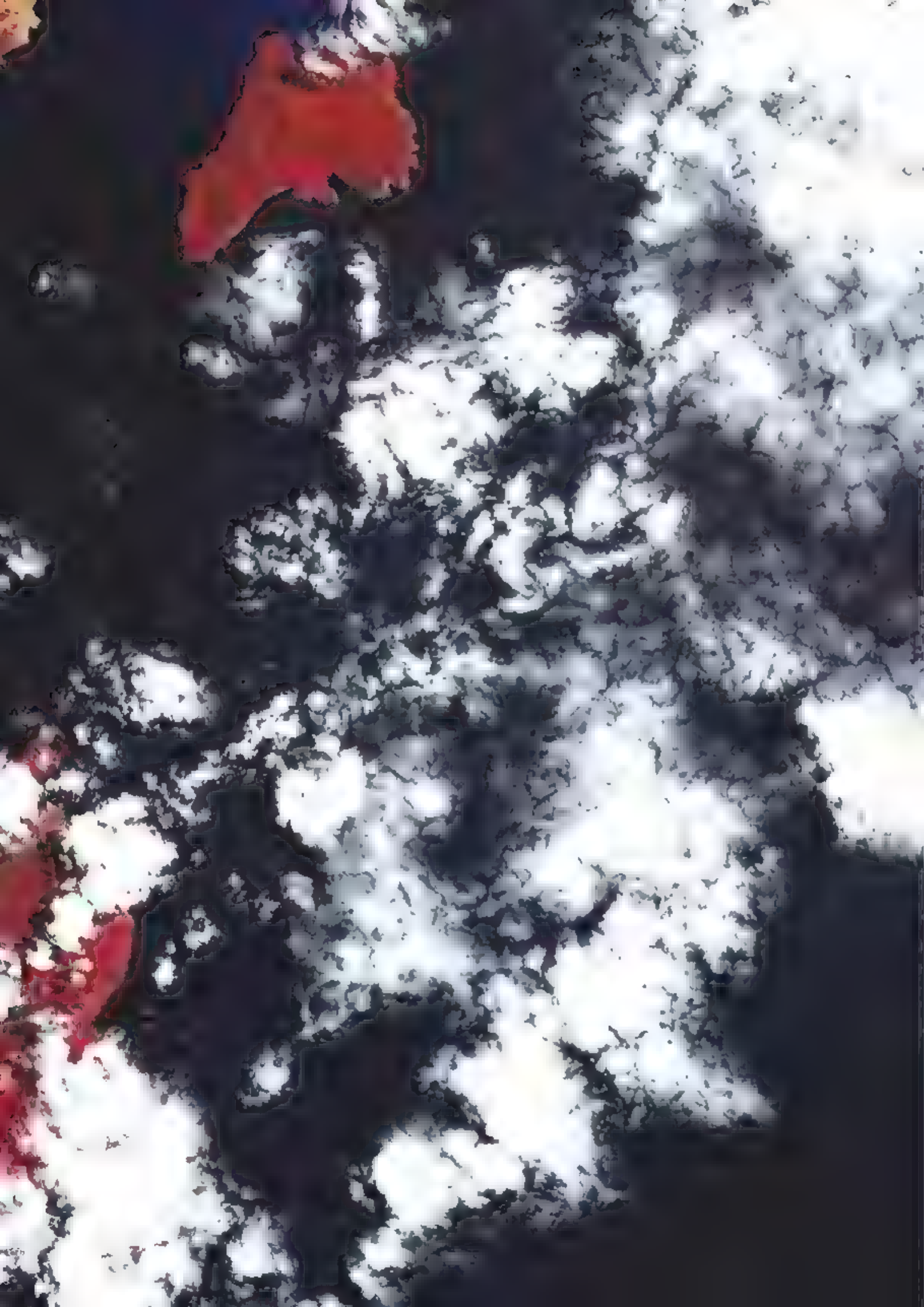
## Forest fires

Tasmania, Australia

January 2013

TASMANIA'S LANDSCAPE BURNED during its so-called 'angry summer'. This false-colour image highlights the damage - red areas represent untouched forest, while brown shows severely burnt land. In total, an area of bushland larger than the city of Amsterdam was charred and over 100 homes were razed to the ground.

PHOTO: NASA/GSFC/ASTER



A satellite photograph of Mexico and the surrounding Pacific Ocean. A massive, dense, yellowish-brown dust plume originates from the northern part of Mexico and extends southwards, covering a significant portion of the country and the Gulf of Mexico. The coastline of Mexico is clearly visible, with the Gulf of Mexico to the east and the Pacific Ocean to the west. The dust storm appears as a thick, billowing cloud of fine particles.

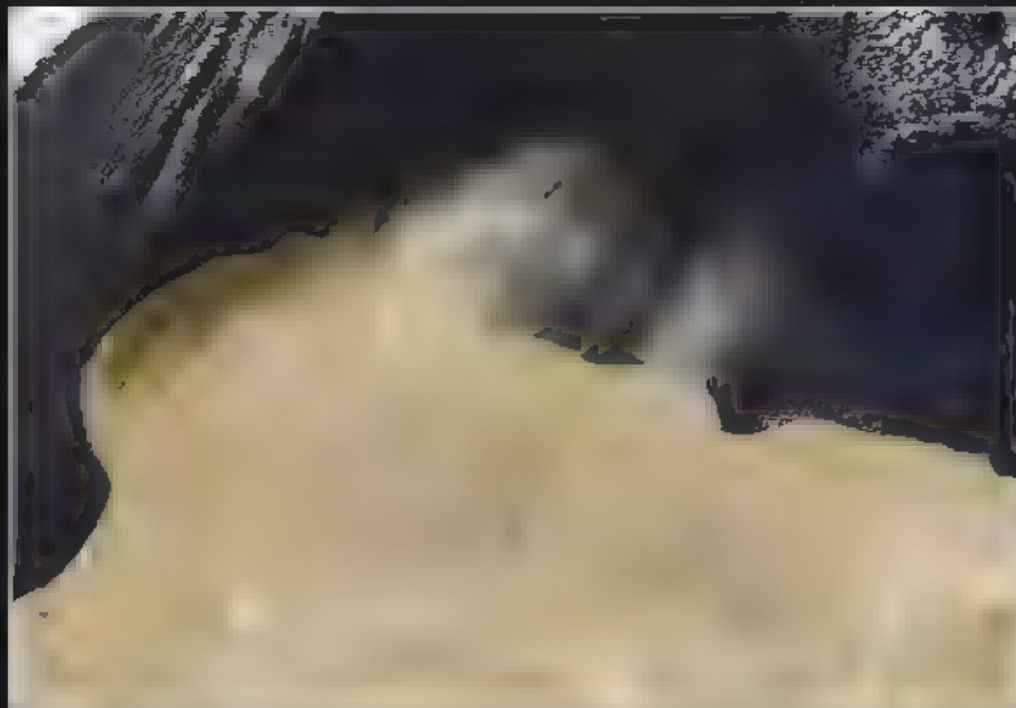
## Dust storms

### Mexico

THE ATMOSPHERE IS constantly reshaping our environment. Here, strong winds have stirred up massive dust storms, carrying tonnes of fine sand across the mainland and the Baja California peninsula into the Pacific.

PHOTO: NASA/OCEANOLOGIST TEAM





## Desert treasure

### Libya

▼ RICH WITH MINERALS, these Saharan dust plumes will land in the Mediterranean - feeding phytoplankton at the start of the food chain - and across Europe.

PHOTO: NASA/JEFF SCHMALTZ


## Catch the drift

### Iran and UAE

▼ TRAPPED IN THE Persian Gulf by a southwesterly wind, a thin veil of dust lingers over the Iranian shore, while a larger cloud escapes in the east.

PHOTO: NASA/GSFC/JEFF SCHMALTZ





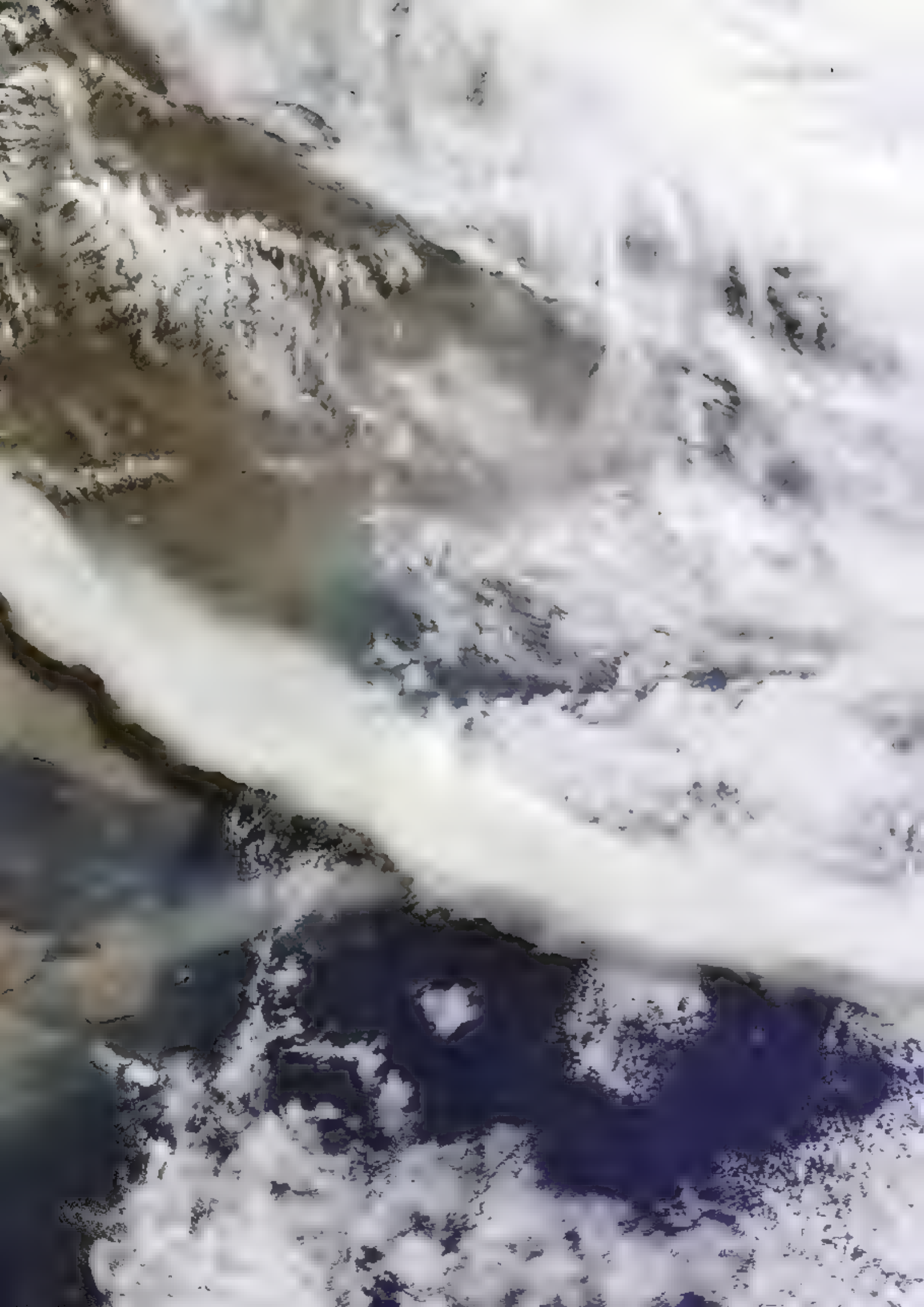
## Puyehue -Cordón Caulle

Chile

6 June 2011

into life at Cordón Caulle and, in doing so, pumps millions of tonnes of ash and pumice into the air. A tall, dense plume spreads north up the border, before being carried across the entire width of neighbouring Argentina by the changing winds.

PHOTO: NASA/ISS/DART





## Mount Etna

Sicily, Italy

27 October 2002

► AFTER A SERIES of small earthquakes, Europe's most active volcano – located in the northeast corner of Sicily – erupts. Streams of lava flow down the summit's slopes, forest fires ignite, and an ash cloud pours into the atmosphere, with volcanic matter falling as far away as Libya.

PHOTO: NASA/BSFC/JEFF SCHMALTZ

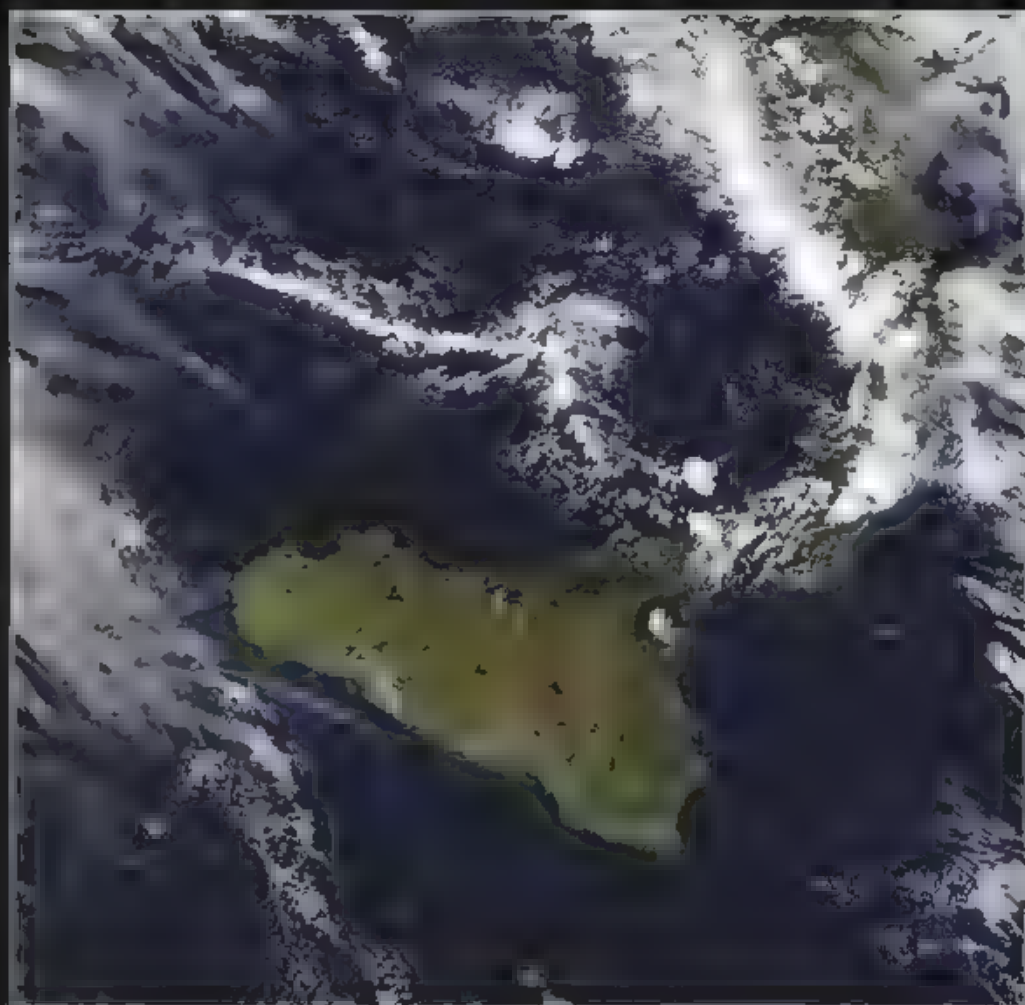
## Nabro Volcano

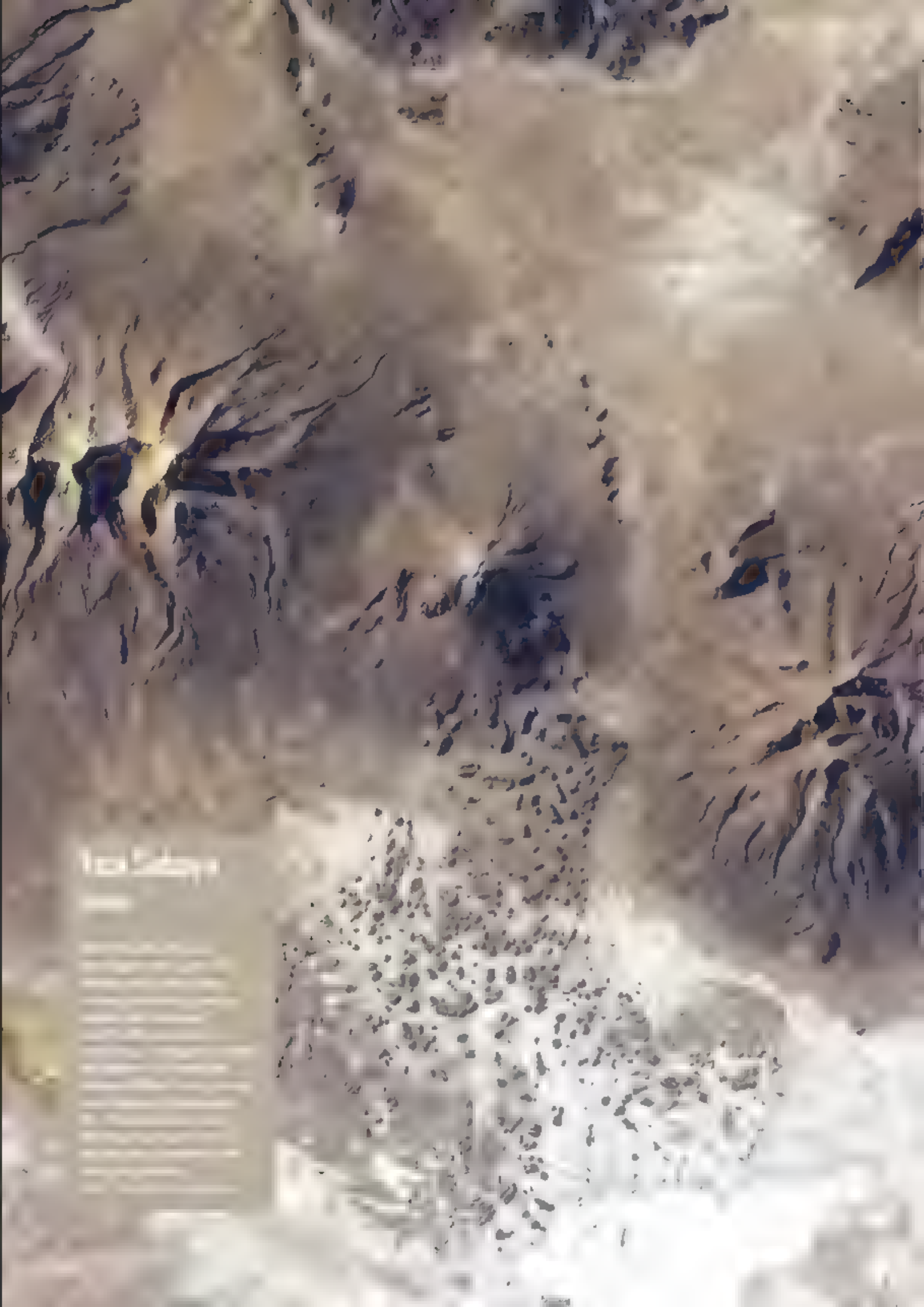
Eritrea

30 June 2011

▼ SEVENTEEN DAYS INTO its eruption, Nabro's ash cloud clears to reveal hot lava running down the volcano's side. The molten rock oozes along the Ethiopian border, until it finally slows and cools when it hits level ground – over 7km west of the summit.

PHOTO: NASA/ROBERT SIMMON



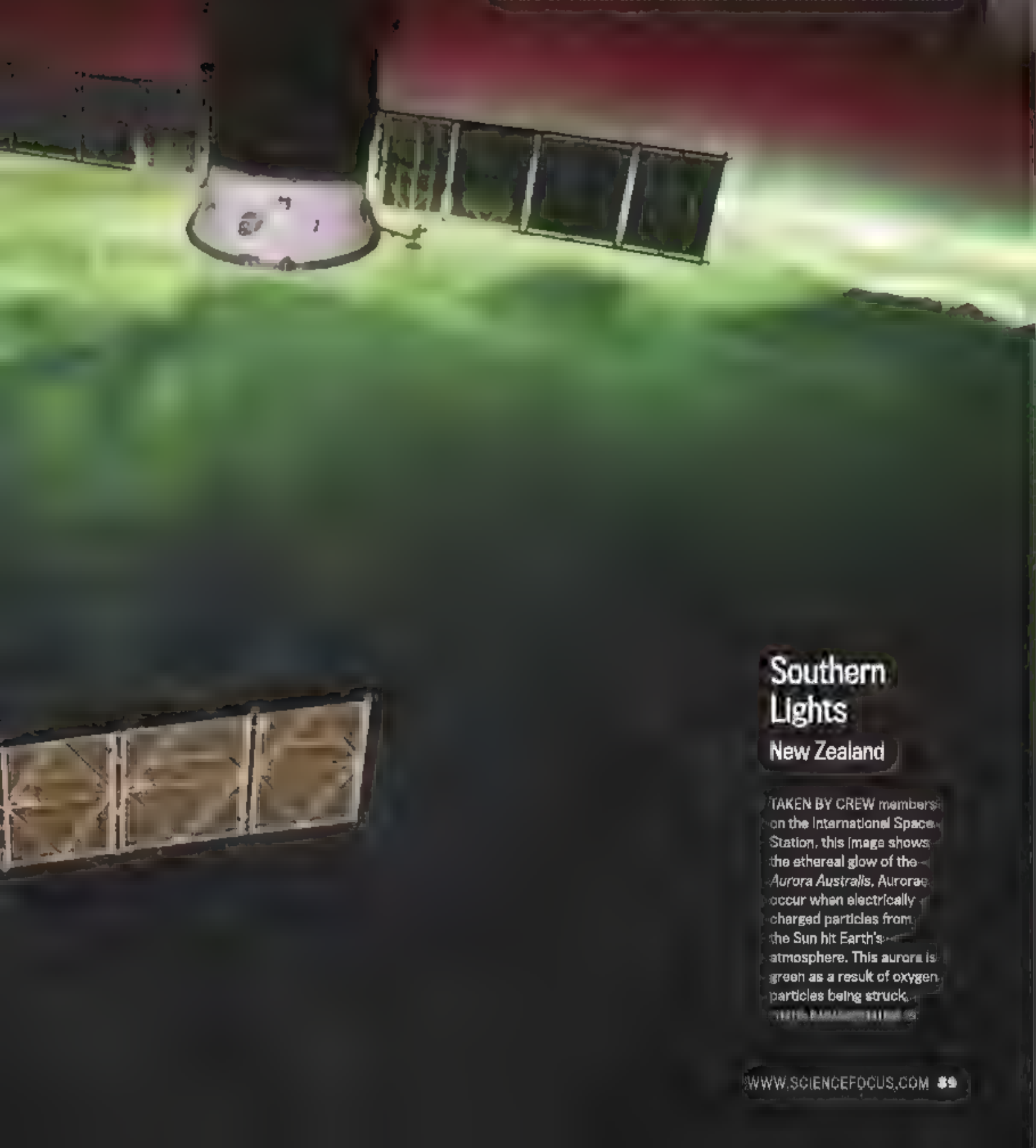






# EARTH AT NIGHT

Cloaked in darkness, at night the planet is transformed into a mass of twinkling lights. The length of the night depends on location and season – the North and South Poles receive 24 hours of Sun in their summers but are blacked out in winter



## Southern Lights

New Zealand

TAKEN BY CREW members on the International Space Station, this image shows the ethereal glow of the Aurora Australis. Aurorae occur when electrically charged particles from the Sun hit Earth's atmosphere. This aurora is green as a result of oxygen particles being struck.

© 2016 NASA/ESA/ISS

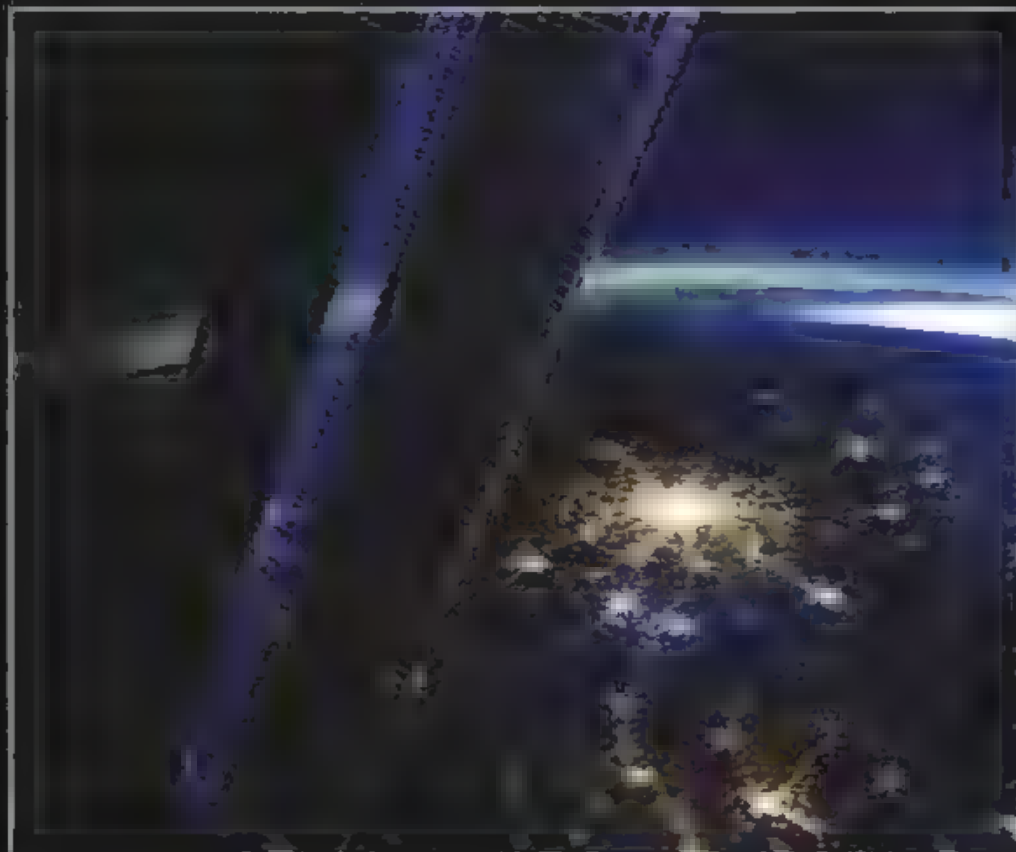


## Shining cities

### Europe

AT NIGHT, EUROPE is ablaze with lights and the capital cities shine out like beacons. Northern Italy, central England and Belgium are all bright because of the concentration of big cities in these areas. In stark contrast, inland Africa is almost completely dark.

PHOTO: NASA/DMSF



## Moscow

Russia

◀ PEERING OUT FROM behind a solar panel of the International Space Station is Europe's second largest city, Moscow, with a population of 11.5 million. On the horizon, daybreak meets the *Aurora Borealis*.

PHOTO: NASA/EXPEDITION 30

## Phoenix

USA

▼ THE STREET GRID pattern of Phoenix is especially evident at night. The city is illuminated by more than 88,500 street lights at a cost of \$10m a year.

PHOTO: NASA/EXPEDITION 35





## Thunderstorm

LIGHTNING FLASHES OVER Earth during this night-time thunderstorm. Lightning is caused by a build up of electrical energy within a cloud. When the charge becomes great enough, it causes lightning to spark out. Earth sees approximately 100 lightning flashes every second.

PHOTO: NASA ISS





# Korean Peninsula

Asia

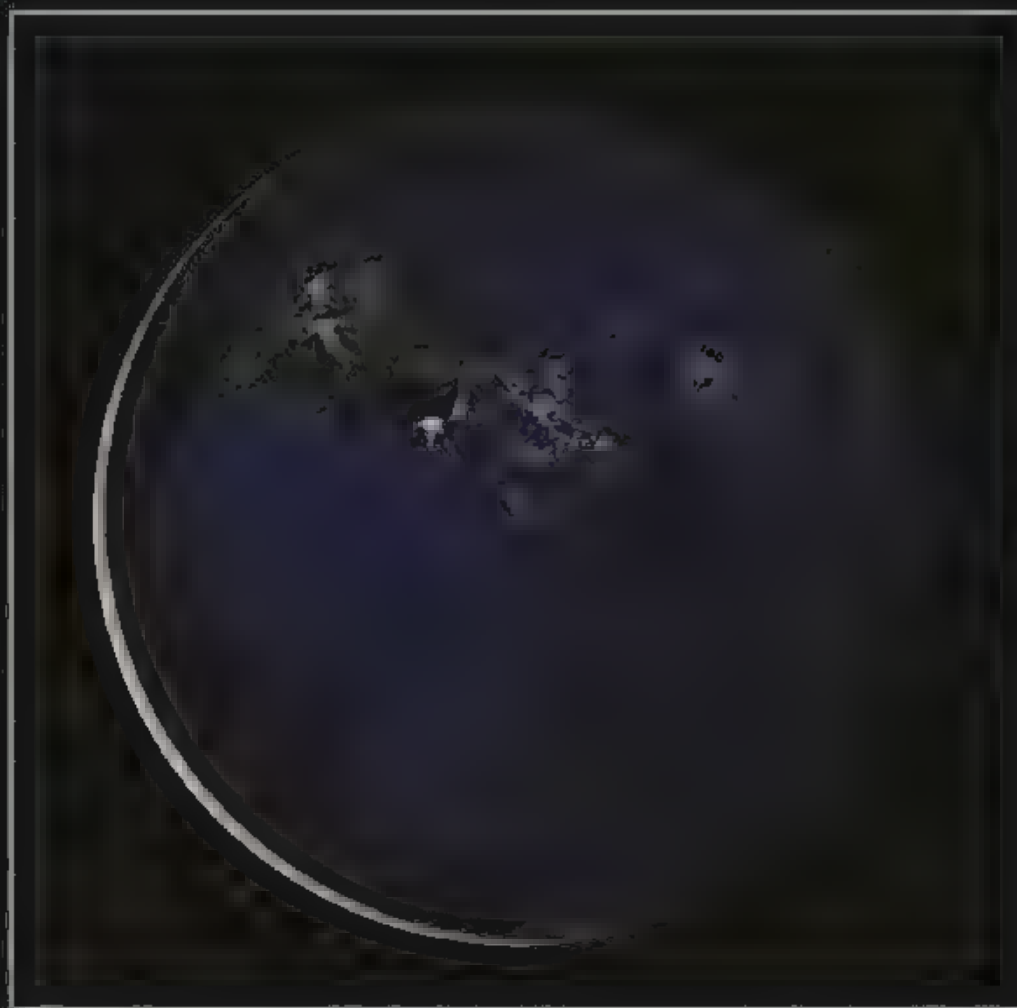
NEVER HAS THE contrast between two countries been more noticeable. In the centre of the image is the brightly-lit South Korea. Above it lies North Korea, enveloped in almost complete darkness.

PHOTO: NASAJESSE ALLEN

ROBERT SIMMON







## Darkness

◀ WHILE AMERICA IS waking, the rest of the world sleeps. The larger cities across Europe and Asia are instantly recognisable. With the exception of the Nile, which is densely populated, the rest of Africa has only a smattering of lights.

PHOTO: NASA/EXPEDITION 28

## Sunset

### Indian Ocean

▼ THIS IMAGE HIGHLIGHTS the different layers of the Earth's atmosphere. The bright orange appears in Earth's troposphere, which extends up to 20km above the surface of the planet. Beyond that is the stratosphere, and the blue layers above mark the transition through the upper atmosphere into the blackness of outer space.

PHOTO: NASA/EXPEDITION 28



## FOCUS SUBSCRIPTION ORDER FORM

**FOBESP13**

☒ **Yes, I would like to subscribe to/renew Focus**  
 £14.40 every 6 issues by Direct Debit **SAVING 40%\***  
 (please complete the form below)

### Instructions to your bank/building society



To: The Manager, Bank/Building Society

Address

Postcode

Name of account holder(s)

Bank/Building Society account number

Branch sort code

Reference number (internal use only)

Originator's identification number:

7 1 0 6 4 4

Please pay Immediate Media Company (UK) Ltd direct debits from the account detailed in the instructions subject to the safeguards ensured by the Direct Debit Guarantee. I understand that this instruction may remain with Immediate Media Company (UK) Ltd and that direct debits will be passed electronically to my Bank/Building Society.

Signature

Date

Banks and Building Societies may not accept Direct Debit mandates from some types of account

### Your details (ESSENTIAL)

Title First name

Surname

Address

Postcode

Home tel: number

Mobile tel: number

As a subscriber to the print edition, you'll also currently receive free access to the Focus iPad app. Free access is a limited offer that may be withdrawn at any time.

### Email address

Immediate Media Company (UK) Ltd (publishers of Focus) would love to keep you informed by post or telephone of special offers and promotions from the Immediate Media Company Group. Please tick if you'd prefer not to receive these.

\*Please enter this information so that Focus may keep you informed of newsletters, special offers and other promotions by email or text message. You may unsubscribe from these at any time. Please tick here if you'd like to receive details of special offers from BBC Worldwide via email.

### Other payments For a year's subscription (13 issues)

UK 13 issues by credit/debit card or cheque for just £38.75 **SAVE 25%**

Europe 13 issues by credit/debit card or cheque for just £54.96

ROW 13 issues by credit/debit card or cheque for just £59.99

### CREDIT CARD

visa Mastercard Maestro

Card no.

Issue no. (Maestro only) [ ] Valid from [ ] [ ] Expiry date

Signature

Date

### Offer ends 31 December 2013

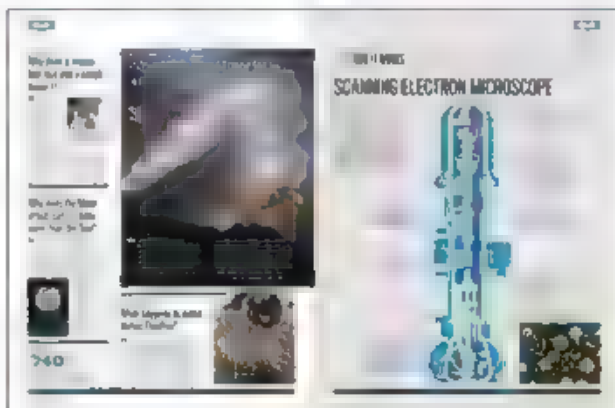
40% saving is available to UK residents paying by Direct Debit only. Your subscription will start with the next available issue.

POST ORDER FORM TO:  
**FOCUS, FREEPOST LON16059,**  
**Sittingbourne, Kent, ME9 8DF**

EVERY MONTH, FOCUS MAGAZINE WILL BRING YOU...



**In-depth features:** groundbreaking stories from the world of science, brought to you by top writers



**Q&A:** do you have a burning question about the world around you? Our panel of experts have the answer



**The latest gear:** all the new technology you'll want to own is tried and tested by our team of reviewers

**And much more...**

**SUBSCRIBE TODAY**

SPECIAL  
SUBSCRIPTION  
OFFER

# SAVE 40%\*

when you subscribe to **FOCUS** today



Your special  
subscription offer:

- **Save 40%** on the shop price, paying **just £14.40 every 6 issues by Direct Debit\***
- Receive every issue delivered direct to your door with **FREE UK delivery**

~~£3.99~~  
**£2.40\***  
an issue

Please  
quote  
FOBESP13



**Subscribe online**  
[www.buysubscriptions.com/FOBESP13](http://www.buysubscriptions.com/FOBESP13)



**Or call now on**  
**0844 844 0257\***

\*Call to this number from a BT landline will cost no more than 10p per minute. Calls from mobiles and other providers may vary. Lines are open weekdays 9am-5pm and Saturdays 9am-5pm. Excludes Northern Ireland, Jersey and Guernsey. © 2013 BBC. All rights reserved.



# PARTING SHOT



## Moonset

### Russia

AS THE MOON dips below the horizon, it appears to be floating in Earth's atmosphere. It is believed that when the Moon was formed it was 14,000km from Earth. However, it moves away from Earth at a rate of 3.8cm per year – roughly the same speed that fingernails grow. Today, our closest companion is over 400,000km from Earth and still moving.

PHOTO: NASA ISS



In 1968, the Apollo 8 astronauts became the first humans to see the Earth as a whole. Ever since, spacecraft and satellites have been delivering new perspectives on our planet.

Today, Earth is constantly observed, and *Earth From Space* presents the most beautiful, poignant and revealing images of your home as you've never seen it before.

